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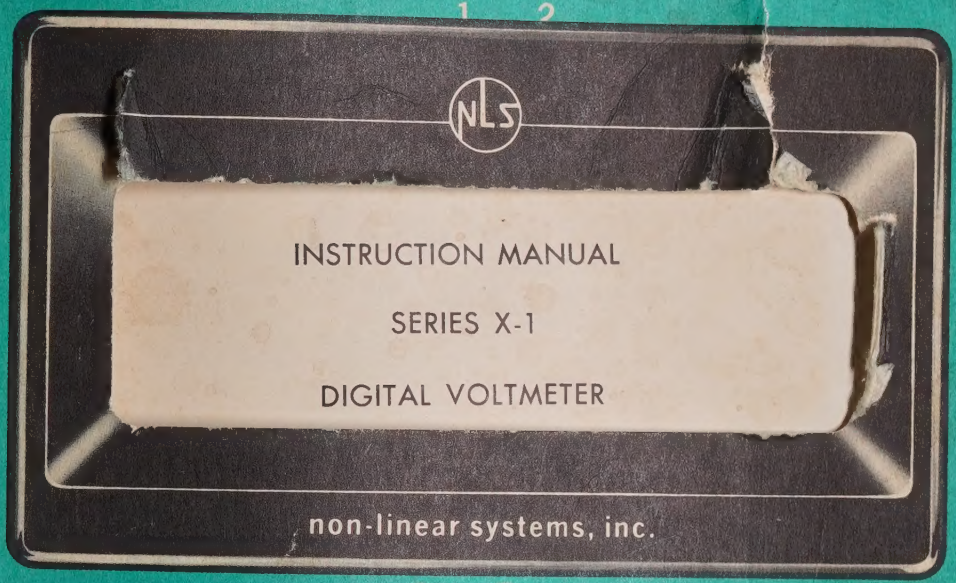

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non linear systems, inc.

DEL MAR, CALIFORNIA

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INSTRUCTION MANUAL

SERIES X-1

DIGITAL VOLTMETER

This Manual Applies to Series X-1 Digital Voltmeters Bearing Part Number 36-218 or 36-315.

Originator of the Digital Voltmeter
non-linear systems, inc.
DEL MAR, CALIFORNIA

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TABLE OF CONTENTS

Chapter	Title	Page
I	INTRODUCTION AND SPECIFICATIONS	1-1
	Scope of Manual	1-1
	Accurate and Stable	1-1
	Easy to Service	1-1
	Measuring Speed	1-3
	Common Mode Rejection	1-3
	Floating Input	1-3
	Specifications, Basic DVM	1-4
	Preamplifier Specifications	1-6
	AC/DC Converter Specifications	1-6
	KΩ-DC Converter Specifications	1-7
II	INSTALLATION AND OPERATION	2-1
	Unpacking	2-1
	Mounting	2-1
	Power Source	2-1
	Fusing	2-1
	Power Grounding	2-1
	Cable Connections	2-1
	Controls	2-2
III	CALIBRATION	3-1
	Scope	3-1
	DC Voltage Calibration	3-1
	Ratio Calibration	3-5
	Pre-Amplifier Calibration	3-5
	Ohms Converter Calibration	3-8
	AC Converter Calibration	3-10
IV	MAINTENANCE	4-1
	Digital Readout Maintenance	4-1
V	RECOMMENDED SPARE PARTS LIST	5-1
	APPENDIX	A-1
	GLOSSARY	G-1

LIST OF TABLES

Number	Title	Page
I	Series X-1 Model Variations by Assemblies	1-2

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1	Dimension Diagram	1-4
2-1	Power Plug Pin Coding	2-1
2-2	Input Connections	2-2
2-3	Rear View	2-4
2-4	Front View	2-4
3-1	DC Volts and MV Calibration Cable Connections	3-3
3-2	Location of Assemblies and DC Voltage Adjustment Points	3-4
3-3	Ratio Reference Assembly Calibration Cable Connections	3-6
3-4	Ratio Reference Assembly Adjustment Points	3-6
3-5	Pre-Amplifier Assembly Adjustment Points	3-7
3-6	Ohms Converter Assembly Calibration Cable Connections	3-9
3-7	Ohms Converter Adjustment Points	3-9
3-8	AC Converter Assembly Calibration Cable Connections	3-11
3-9	AC Converter Adjustment Points	3-11
4-1	Series X-1 DVM Flow Diagram	4-3
4-2	Block Diagram X-1 DVM with Printout Function	4-4
4-3	Block Diagram X-1 DVM without Printout Function	4-5
4-4	Polarity Gate	4-6
4-5	Forbidden Upper Range Gate	4-6
4-6	Forbidden Lower Range Gate	4-7
4-7	Upper Limit Range Gate	4-7
4-8	Lower Limit Range	4-8
4-9	Simplified Diagram Pre-Amplifier Assembly	4-8
4-10	Simplified Diagram Ohms Converter Assembly	4-9
4-11	Simplified Diagram AC Converter Assembly	4-10
4-12	Lamp Bulb Contact Points	4-11
4-13	Readout Module Removal	4-11
4-14	Readout Module	4-12
4-15	Readout Module with Cover and Lamp Board Assembly Removed	4-12

LIST OF SCHEMATIC DIAGRAMS

36-8	Decade Counter Assembly
36-11	Reference Assembly
36-14	Decade (1-4) Assembly
36-16	Decade (5) Assembly
36-26	Comparator Assembly
36-43	Inverter Assembly
36-67	Decode Assembly
36-73	Threshold & Clock Assembly
36-179	Transfer Board No. 1 Assembly (DVM P/N 36-218)
36-182	Transfer Board No. 2 Assembly (DVM P/N 36-218)
36-185	Transfer Board No. 3 Assembly (DVM P/N 36-218)
36-191	Function Relay Assembly
36-218 Sheet 4	Signal Input, Digital Input and Output Data
36-219	Readout Unit Assembly
36-220	Power Supply Assembly (DVM P/N 36-218)
36-221	Function Unit Assembly
36-248	Rectifier Assembly
36-249	Program Counter Assembly
36-266	Regulator Assembly
36-269	Polarity Flip-Flop Assembly
36-272	Range Counter Assembly
36-275	Scan Counter Assembly
36-296	Filter Assembly
36-314	Buffer Assembly
36-320	Range Limit Logic Assembly
36-324	Range Decision Assembly
36-474	Power Supply Assembly (DVM P/N 36-315)
36-494	Scan Control Assembly (DVM P/N 36-315)
15004-525	Input Cable Assembly

OPTIONAL ACCESSORIES

36-97	AC Converter Assembly
36-188	Ohms Converter Assembly
36-195	Ratio Reference Assembly
36-234	Pre-Amplifier Assembly

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CHAPTER I

INTRODUCTION AND SPECIFICATIONS

The NLS Series X-1 Digital Voltmeter is a three-range, five-digit instrument with automatic range and polarity functions. Provisions for 20% overranging are incorporated. Its circuitry is all solid state and its principle of analog-to-digital conversion is all-electronic successive approximation scan logic. The instrument may be used as a bench model or may be rack-mounted.

SCOPE OF MANUAL

This manual specifically applies to two models of the Series X-1 Digital Voltmeter as described in the preceding paragraph. One model has digital output and remote control capabilities (P/N 36-218) and the other does not (36-315). Table I lists the drawer assemblies and major subassemblies (with quantities) of each model. In addition to the basic DC voltage measurement, these two models of the Series X-1 are capable (at customer's option) of measuring ratio, AC voltage, millivolts and ohms. For ratio measurement, Reference Supply Assembly (P/N 36-11) is replaced by Ratio Reference Assembly (P/N 36-195). For AC measurement, an AC Converter Assembly is inserted into J12 of the Function Unit Assembly (right hand drawer). For MV measurement, a Pre-Amplifier Assembly is inserted into either J12 or J13 of the Function Unit Assembly. For KΩ measurement, an Ohms Converter Assembly is inserted into J13 of the Function Unit Assembly. Schematic and wiring diagrams for each model and accessories will be found at the end of this manual.

ACCURATE AND STABLE

The Series X-1 operates as an automated version of the laboratory potentiometer, the most accurate voltage measuring device. That is, it generates a feedback voltage equal to the unknown input voltage in discrete steps, by operating a precision voltage divider, energized by a highly regulated power supply.

High-speed, reliable transistor switches operate the Series X-1's voltage divider, which is composed of precision resistors. The switches are so stable that adjustment potentiometers are not required to compensate for switch drift. Voltage for the divider is controlled by two Zener diodes which have been carefully selected to ensure that their combination results in a temperature coefficient sufficiently low to provide an ultra-stable supply. A temperature stabilizing oven is not required.

EASY TO SERVICE

The operational assemblies of the instrument are housed in three separate, easily removed, plug-in drawers and virtually all components within these drawers are mounted on plug-in circuit boards for easiest access and replacement. It is thus possible to keep the instrument operative with a minimum of down-time. For example, logic and feedback voltage generator circuits common to any one decade (readout window) are mounted on a separate board and four of the five

Table I. Series X-1 Model Variations by Assemblies

	REMOTE CONTROL AND PRINTOUT (P/N 36-218)	QTY	WITHOUT REMOTE CONTROL AND PRINTOUT (P/N 36-315)	QTY
Decade Counter Assembly	36-8	2	36-8	2
Reference Assembly	36-11	1	36-11	1
Decade (1-4) Assembly	36-14	4	36-14	4
Decade (5) Assembly	36-16	1	36-16	1
Comparator Assembly	36-26	1	36-26	1
Inverter Assembly	36-43	1	36-43	1
Decode Assembly	36-67	5	36-67	5
Threshold & Clock Assembly	36-73	1	36-73	1
Transfer Board No. 1 Assembly	36-179	1	-----	0
Transfer Board No. 2 Assembly	36-182	1	-----	0
Transfer Board No. 3 Assembly	36-185	1	-----	0
Function Relay Assembly	36-191	1	36-191	1
Readout Unit Assembly	36-219	1	36-219	1
Power Supply Assembly	36-220	1	36-474	1
Function Unit Assembly	36-221	1	36-221	1
Rectifier Assembly	36-248	1	36-248	1
Program Counter Assembly*	36-249	2	36-249	1
Regulator Assembly	36-266	1	36-266	1
Polarity Flip-Flop Assembly	36-269	1	36-269	1
Range Counter Assembly	36-272	1	36-272	1
Scan Counter Assembly*	36-275	1	-----	0
Filter Assembly	36-296	1	36-296	1
Buffer Assembly	36-314	1	36-314	1
Range Limit Logic Assembly	36-320	1	36-320	1
Range Decision Assembly	36-324	1	36-324	1
Scan Control Assembly*	-----	0	36-494	1

*On DVM P/N 36-315: 1. Scan Control Assembly, 36-494, is substituted for Scan Counter Assembly, 36-275 (Connector J3 of Function Unit Assembly).

2. Program Counter Assembly, 36-249, is inserted into Connector J5 of Function Unit Assembly. Connector J4 (although wired for use) is without a board assembly.

decade boards (decades 1 thru 4) are completely interchangeable within the instrument. The five decode boards are also completely interchangeable. Should any of the first four decade boards or any of the decode boards fail, it can be omitted from the right-most (1st decade) and the Series X-1 will still operate, but as a 4-digit instrument (e.g., if the input were 4.7391, the readout would display 4.739). This maintenance philosophy enjoys wide acceptance among instrument users who require that both trained and untrained personnel be able to service the instruments.

MEASURING SPEED

The speed of the Series X-1 instrument, depending upon range and polarity changes required, will vary from 16 to 106 milliseconds per reading. Range changes occur when the previous measurement is not within the proper range for the new measurement; that is, the range changes only when required. Unlike many other instruments, the Series X-1 does not revert to the lowest range between readings.

"Range Memory" increases over-all measuring speed by preventing needless ranging. It does this by remembering the range last used and using it for the next measurement if suitable (i.e., if the next voltage is neither above full scale of the range last used, nor lower than 1/10 of it).

The Series X-1 utilizes fixed sequence logic. With this logic, the instrument creates a feedback voltage equal to the input, and feedback voltage changes are made decade by decade in one programmed scan, starting with the left-most decade (left-most readout window) and progressing to the right. Even if the input voltage varies during measurement, the instrument's reading represents a valid voltage value that existed during the measuring cycle. In contrast, instruments having digital servo logic (tracking logic) will "hunt" continuously as long as the input varies by more than one digit. Hunting can only be stopped by decreasing DVM comparison amplifier gain, which must be done manually since the gain should be reduced only enough to prevent hunting.

COMMON MODE REJECTION

Rejection of common-mode signals, those caused by AC or DC currents flowing between signal source ground and instrument chassis ground, is a key feature of the Series X-1 DVM. Common-mode signal rejection (CMR) is important in a wide range of applications - testing complex electrical and electronic systems, in automatic measuring systems, and measuring outputs from thermocouples, strain gages and other transducers where common-mode signals may be many times greater than the measured DC voltage.

FLOATING INPUT

Because input signal leads are not connected to the Series X-1's outer chassis, signal-to-chassis potentials up to 500 volts are permissible. Floating input adds to the DVM's versatility by permitting it to measure voltage sources which could not be accurately measured by a non-isolated meter.

The NLS Sales Representatives or Engineering Department will be pleased to assist you with specific application problems and, of course, will gladly welcome your comments and suggestions. A contact with the nearest NLS office or to the main office in Del Mar, California will bring prompt response.

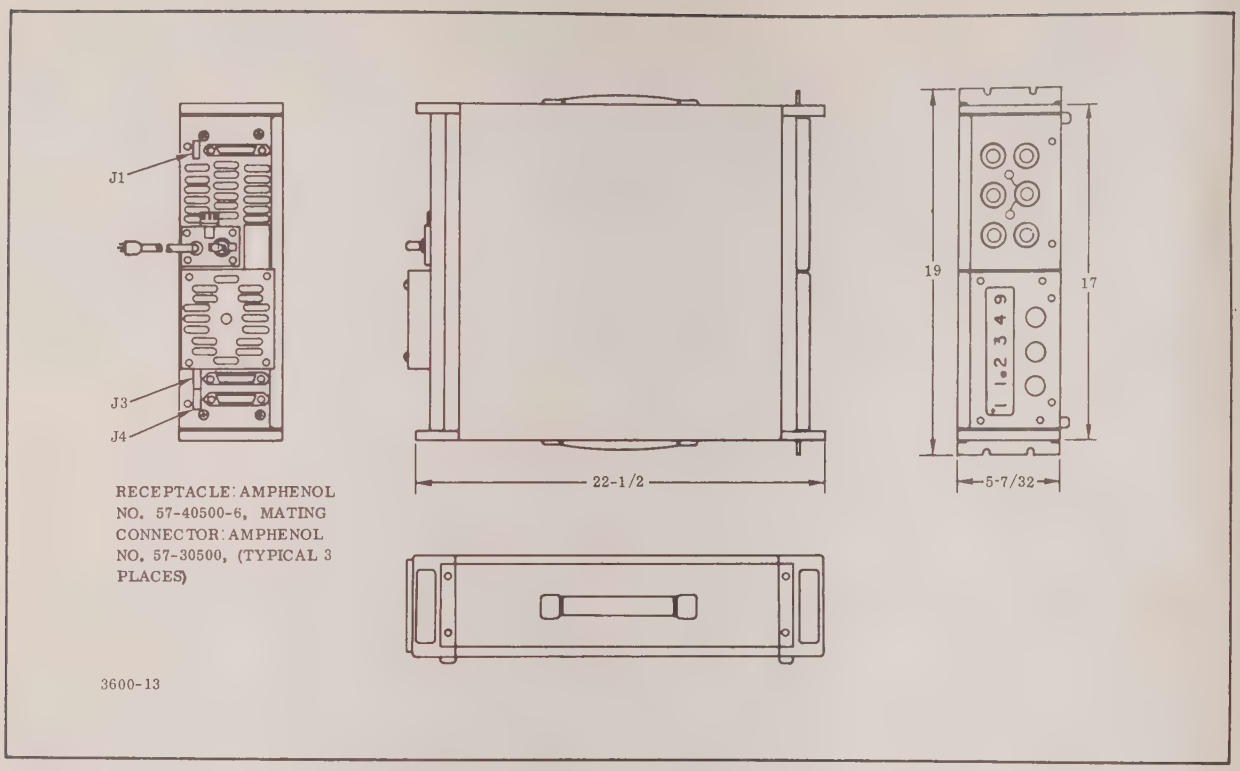


Figure 1-1. Dimension Diagram

SPECIFICATIONS, BASIC DVM

CIRCUITRY:	All solid state.
PRINCIPLE OF ANALOG-TO-DIGITAL CONVERSION:	All-electronic successive approximation scan logic.
COMMON-MODE REJECTION:	120 DB, VDC - 60 CPS.
FULL SCALE DC RANGES:	±9.9999, ±99.999, ±999.99 with 20% overrange on the two lower ranges.
ACCURACY UNDER ASA REFERENCE CONDITIONS:	0.001% of full scale +0.005% of reading.
RESOLUTION:	One digit.
RESPONSE TIMES:	Input Buffer Response Time - 10 MS.
	Digitizing Time - 6 MS.

RESPONSE TIMES (CONT):	Time Required for Transfer Relays to Operate - 7 MS.
	Time to Select a Fixed Range Remotely (Operate Time of Range Transfer Relay + Operate Time of Range Selection Relay) - 10 MS.
	Time Required for Each Automatic Range Change - 30 MS.
	Time Required for Each Automatic Polarity Change - 30 MS.
INPUT RESISTANCE:	10V Range - 10,000 megohms.
	100V Range and 1,000 Range - 10 megohms.
	Input resistance is constant except when input is overloaded.
FILTER:	Manual and remote switching.
	37 DB minimum at 60 Hz and above.
	Settling Time to Within 0.01% with up to 100K Source Resistance - 2 seconds.
	Type - 1 pole, 6 DB/octave.
METHODS OF CONTROL:	Range Selection - Automatic, manual and remote.
	Polarity Selection - Automatic, manual and remote.
	Start Command - Internal, external and manual.
	Function Selection - Manual and remote.
OUTPUT CONNECTIONS:	Output Data - BCD contact closures for isolated output. BCD voltage levels if isolation is not required.
	Digital Output Command - Contact closure for isolation. Voltage level if isolation is not required.
SIGNAL INPUT CONNECTIONS:	Signal inputs are on rear panel only. They consist of Sense Hi, Sense Lo, Guard, Current +, Current -, and Ref. In. These inputs may be floated ±500 VDC with respect to chassis ground (earth).
AMBIENT TEMPERATURE:	$12^{\circ}C$ to $40^{\circ}C$.

POWER REQUIREMENTS:	115 VAC, 50 - 60 CPS.
MOUNTING POSITION:	Due to the mercury-wetted relay, utilized for polarity switching, the mounting position must be restricted to within 30° of horizontal.
WEIGHT:	Approximately 50 pounds.

RATIO

RANGES:	±1.19999/±11.9999/±99.999
ACCURACY UNDER ASA RATED CONDITIONS:	0.001% FS + 0.002% reading (short term)

PREAMPLIFIER SPECIFICATIONS

RANGES:	119.99, 1199.99 MVDC
ACCURACY UNDER ASA REFERENCE CONDITION:	±(0.01% of reading + 0.01% of full scale)
STABILITY:	Short Term: ±(0.01% of full scale)
	Long Term: See rated accuracy
RESPONSE TIME:	Step to 0.01% of final value: 1 second*
	Each range change to 0.01% of final value: 1 second*
INPUT CHARACTERISTICS:	Resistance, steady state: 100 MΩ, minimum
	Resistance, Dynamic: 20 KΩ, minimum

AC/DC CONVERTER SPECIFICATIONS

RANGES:	Frequency: 50 Hz to 10 KHz
	Amplitude: 1.19999, 11.9999, 119.999, 500.00 VAC

NOTE: a. Has front panel zero adjust.
b. Can use DVM signal on noisy signals.

*Response time is considerably increased for signals whose source resistance is higher than 10 KΩ.

ACCURACY UNDER ASA REFERENCE CONDITION:	±(0.1% of reading + 0.05% of full scale)
STABILITY:	Short Term: ±0.02% of full scale
	Long Term: See rated accuracy
RESPONSE TIME:	Step to 0.1% of final value: 600 milliseconds
	Range to 0.1% of final value: 630 milliseconds
INPUT CHARACTERISTICS:	Resistance: 1 meg ± 1% (all ranges)
	Capacitance: 100 PF maximum (all ranges)

KΩ-DC CONVERTER SPECIFICATIONS

RANGES:	1.19999, 11.9999, 119.999, 1199.99, 11999.9 KΩ
ACCURACY UNDER ASA REFERENCE CONDITIONS:	±(0.01% of reading +0.001% of full scale), lowest three ranges ±(0.03% of reading +0.001% of full scale), 1,000 KΩ range ±(0.1% of reading +0.001% of full scale), 10,000 KΩ range
STABILITY:	Short Term: ±(0.005% of full scale), lowest three ranges Long Term: See rated accuracy
RESPONSE TIME:	Step to 0.01% of Final Value, 4 Lowest Ranges: 100 MS 0.1% of Final Value, Highest Range: 0.7 SEC
	Each Range Change to 0.01% of Final Value: 630 milliseconds* (Highest range settles to 0.2% in 630 milliseconds)
TEST VOLTAGES AND CURRENTS:	Voltage across unknown: 16 VDC all ranges
	Current through unknown: 10 MA lowest range 1 MA on higher ranges

NOTE: a. Has front panel zero adjust.
b. Can use DVM signal on noisy signals.

*If highest range is not needed, speed can be markedly improved.

CHAPTER II

INSTALLATION AND OPERATION

UNPACKING

The instrument is shipped in a heavy cardboard container. Cut the tape on the top of the container and open. If damage is seen, promptly notify the carrier. No packing materials are used inside of the instrument and it is ready for use when taken out of the shipping container. It is suggested that the container be saved if future storage or shipment is contemplated.

MOUNTING

The unit may be mounted in a standard 19-inch mounting rack (mounting brackets for this utilization are provided) or may be used as a bench instrument. Due to the mercury-wetted relay utilized for polarity switching, the mounting position must be restricted to within 30^{o} of horizontal.

POWER SOURCE

The instrument requires a 115-volt, 50-60 cycle, single-phase power source for operation.

FUSING

The instrument is protected by a 3AG one-ampere slo-blo fuse which is located in an extractor post on the rear of the power supply unit.

POWER GROUNDING

The third pin of the power plug grounds the outer chassis of the instrument (Figure 2-1). The three internal drawers have no connection to chassis ground.

CABLE CONNECTIONS

The instrument is supplied with an input cable for connection to input connector J1 (see Figure 2-2, cable drawing 15004-525 and applicable calibration instructions for connection information.) Mating connectors are supplied for remote control connector J3 and

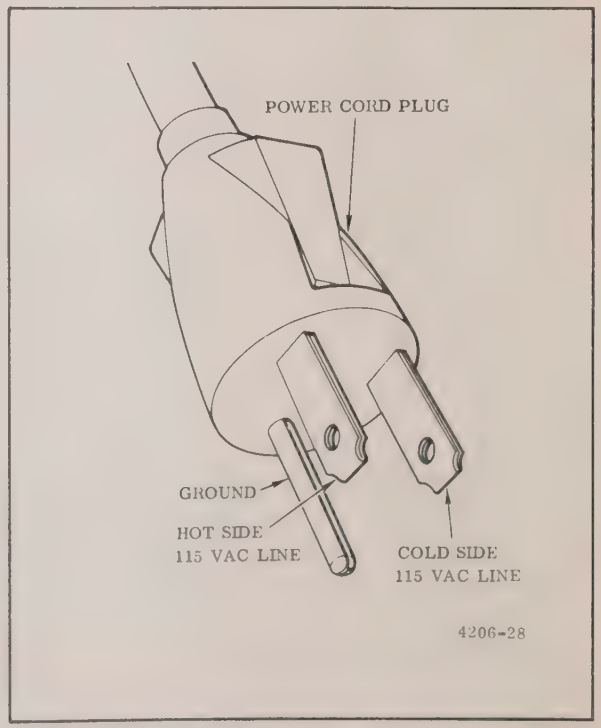


Figure 2-1. Power Plug Pin Coding

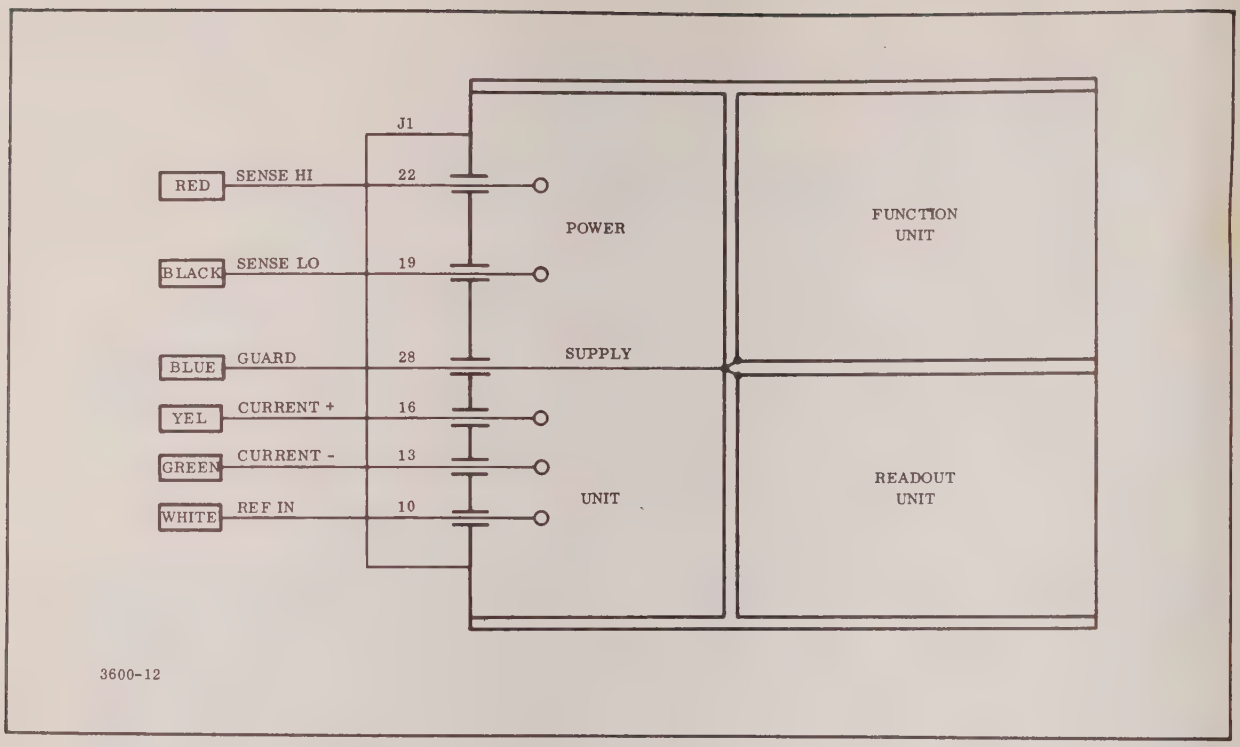


Figure 2-2. Input Connections

digital output connector J4 (see drawing number 36-218, sheet 4, for connection information). See Figure 2-3 for location of all connectors.

CONTROLS

READOUT UNIT

Threshold Control

Associated with any number stored in the decade flip-flops (and displayed in the readout), is a dead band from which the input signal must emerge (in the positive or negative direction) before a new measurement will result in a new reading.

The THRESHOLD control (a potentiometer) is used to set the width of the dead band. With the control in the extreme counterclockwise position, the dead band width is essentially zero. With the control in the extreme clockwise position, the dead band width is approximately 10 digits, in the least significant decade.

Measurement of inputs outside the dead band are made at full accuracy, the effect of the THRESHOLD control being automatically cancelled out.

The THRESHOLD control can be used to reduce bobble in the readout display.

Digital Output Switch

The DIGITAL OUTPUT control is a two-position switch in series with the common line which, when the switch is ON, feeds the coils of the data transfer relays and the print

command relay. Whenever the instrument is not being used with a recording device, it is recommended that the DIGITAL OUTPUT switch be placed in the OFF position to prolong the life of the transfer relays. This switch is wholly ineffective on the Series X-1 model without remote control and printout capabilities (P/N 36-315).

Offset Plus Control

The OFFSET PLUS control is a potentiometer which can offset the meter reading by up to approximately ten digits (except when the reading is near all zeros). Its use is described in Section III, Calibration Instructions under Zero Offset Adjustments.

FUNCTION UNIT

Polarity Switch

The POLARITY switch is a four position switch providing for the manual selection of either plus (+) or minus (-) polarity readings or, as when in the AUTO position, allowing the instrument to automatically select the proper polarity. When the switch is placed in the REMOTE position, polarity selection may be made by an external triggering device.

Filter Switch

The FILTER switch has three positions. When in the OUT position, the filter is disconnected. When in the IN position, the filter is connected and the reading time of the instrument is automatically increased to allow for filter response time. When the switch is placed in the REMOTE position, filter selection may be made by an external triggering device.

Range Switch

The RANGE switch has seven positions. When in the 1 position, the instrument is locked in the 1-volt range for the measurement of AC voltages or in the 1KΩ range for the measurement of ohms. When in the 10 position, the instrument is locked in the 10-volt range for the measurement of AC, DC and ratio voltages or in the 10KΩ range for the measurement of ohms. When in the 100 position, the instrument is locked in the 100-volt range for the measurement of AC, DC and ratio voltages, in the 100 MV range for the measurement of millivolts or in the 100KΩ range for the measurement of ohms. When in the 1000 position, the instrument is locked in the 1000-volt range for the measurement of AC, DC and ratio voltages, in the 1000 MV range for the measurement of millivolts or in the 1 MEG range for the measurement of ohms. When in the 10000 position, the instrument is locked in the 10 MEG range for the measurement of ohms. When in the AUTO position, the instrument automatically selects the proper range. When in the REMOTE position, range selection may be made by an external triggering device.

Offset Minus Control

The OFFSET MINUS control is a potentiometer which, in the minus polarity only, can offset the meter reading by up to approximately ten digits (except when the reading is near all zeros). Its use is described in Section III, Calibration Instructions under Zero Offset Adjustments.

Scan Mode Switch

The SCAN MODE switch has four positions. When in the INT. position, the readings are initiated internally. When in the EXT. position, the readings are initiated externally by

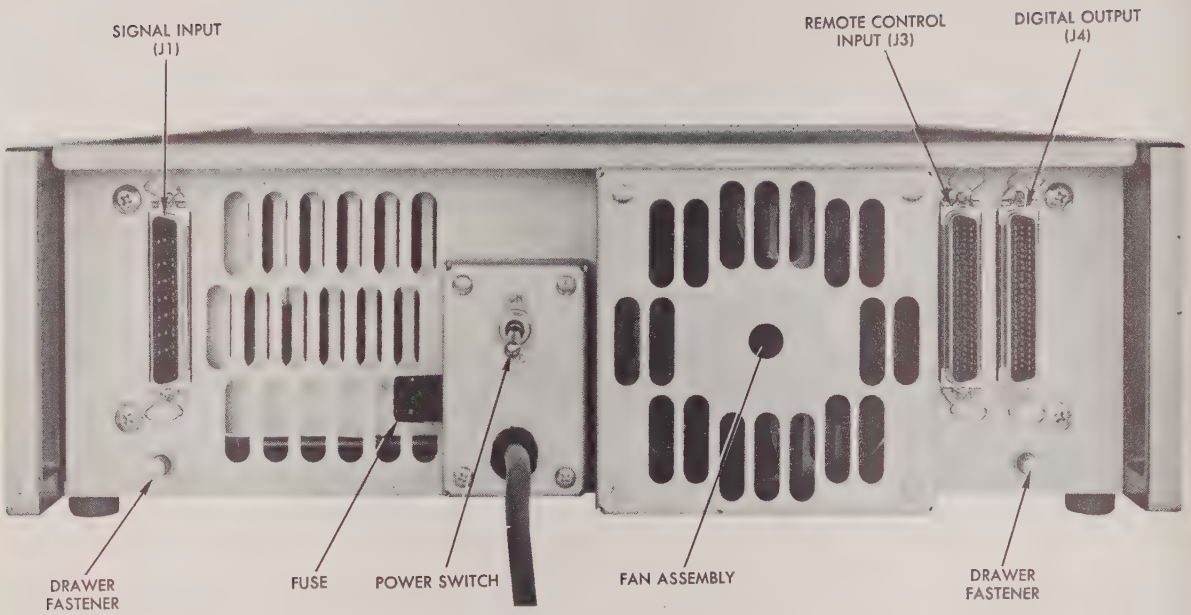
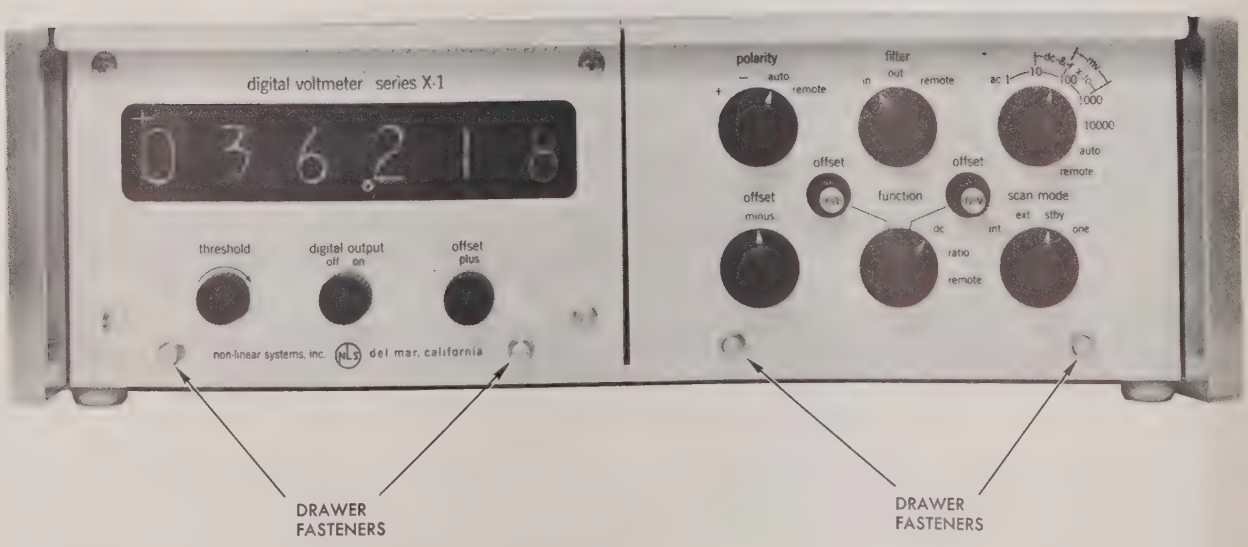


Figure 2-3. Rear View



3600-14

Figure 2-4. Front View

de-energizing the trigger hold-off relay (see drawing number 36-218, sheet 4). If only a single reading is desired, the trigger holdoff relay should be de-energized and then energized within a period of seven milliseconds. When in the STBY. position, the power is on but the instrument cannot be triggered either internally or externally and the last measurement remains stored. The ONE position is spring loaded. Moving the switch to this position causes the instrument to make a single measurement. If a recording device is in use, returning the switch from the ONE position to the STBY. position causes the data obtained from the single measurement to be transferred to the recording device. The REMOTE position is ineffective on the Series X-1 model without remote control and printout capabilities (P/N 36-315).

Function Switch

The FUNCTION switch has five positions. The most counterclockwise position selects the function of the accessory board which is inserted into J13 of the Function Unit Assembly (either KΩ or MV). The second-most counterclockwise position selects the function of the accessory board which is inserted into J12 of the Function Unit Assembly (either AC or MV). The DC position is utilized for DC voltage measurements. The RATIO position is utilized for ratio measurements. When the switch is in the REMOTE position, function selection may be made by an external triggering device.

KΩ/MV Offset Control

The KΩ/MV OFFSET control is a potentiometer provided to zero the instrument when in the KΩ or MV function. Its use is described in the KΩ and MV calibration instructions.

AC/MV Offset Control

The AC/MV OFFSET control is a potentiometer provided to zero the instrument when in the AC or MV function. Its use is described in the AC and MV calibration instructions.

POWER SUPPLY UNIT

Power Switch

The power switch is a two-position toggle switch located on the rear of the power supply unit. In the OFF position, the instrument is de-energized and both power leads are isolated from the power source; however, connection is maintained between the outer chassis and AC power line ground. In the ON position, the instrument is ready to provide readings. For maximum specified accuracy, a warm-up period of 30 minutes is recommended.

CHAPTER III

CALIBRATION

In the calibration instructions provided in this section, it is assumed that the instrument is in good working order and only requires calibration. If any components are defective, it may be difficult, if not impossible, to calibrate the instrument properly.

SCOPE

The basic DC calibration procedure is divided into six distinct areas: zero offset adjustments; 10-volt range calibration for a positive input; 10-volt range calibration for a negative input; 100-volt range calibration; 1000-volt range calibration; and zero offset readjustment with DVM in outer chassis.

Since the X-1 DVM, P/N's 36-218 and 36-315, are capable of ratio, millivolts, AC and ohms measurements, at customer option, calibration procedures for these accessories are also included.

NOTE

Due to the mercury-wetted relay, used for polarity switching, the mounting position of the DVM must be restricted to within 30° of horizontal.

DC VOLTAGE CALIBRATION

EQUIPMENT REQUIRED

1. A voltage standard between 9.0000 volts and 11.9998 volts, to calibrate the 10-volt range.
2. A voltage standard between 90.000 volts and 119.998 volts, to calibrate the 100-volt range.
3. A voltage standard between 900.00 volts and 1000.00 volts, to calibrate the 1000-volt range.

NOTE

It should be noted that the error in making a measurement with the Series X-1 DVM can be as much as the stated accuracy of the instrument plus the accuracy of the voltage standards used in its calibration.

INITIAL PREPARATION

CAUTION

Do not disconnect drawer assemblies with power on. Damage to plug-in modules may result.

1. Loosen (turn counterclockwise) the two fasteners on each of the three drawers and remove the drawers from the outer chassis of the instrument.
2. Connect the three drawers together and plug the power cord into a 115 VAC, 50-60 CPS power source.
3. Turn the instrument on and allow 30 minutes for warm-up.

PROCEDURE

Zero Offset Adjustments

1. Place SCAN MODE switch in the INT. position.

2. Place RANGE switch in the 10 position.

3. Turn THRESHOLD control fully counterclockwise.

4. Place POLARITY switch in the plus (+) position.

5. Connect the red, black and blue clips of the DVM input cable together. Rotate the OFFSET PLUS control to a position which causes the readout to alternate between +00. 0000 and +00. 0001. Turn the periphery of the knob approximately 3/32 of an inch counterclockwise.

6. Place the POLARITY switch in the minus (-) position.

7. Rotate the OFFSET MINUS control to a position which causes the readout to alternate between -00. 0000 and -00. 0001. Turn the periphery of the knob approximately 3/32 of an inch counterclockwise.

8. This completes the zero offset adjustments. If the adjustments have been made correctly, the readout should display a steady + or -00.0000 with the input leads shorted together and the POLARITY switch in the AUTO position.

10-Volt Range Calibration for a Positive Input Voltage

1. Connect the "guard" (blue) and "input low" (black) leads of the DVM input cable to the negative terminal of the voltage standard described in paragraph 1 under Equipment Required. Connect the "input high" (red) lead to the positive terminal (Figure 3-1).

2. Place the POLARITY switch in the plus (+) or AUTO position.

3. The numerical value displayed in the readout should be equal to the voltage of the voltage standard. If it is not, adjust potentiometer R1 of the Reference Assembly (P/N 36-11) until the readout displays the correct value. If the instrument has a Ratio measurement function, the adjustment potentiometer will be R1 of the Ratio Reference Assembly (36-195). See Figure 3-2 for location of major subassemblies and adjustment potentiometers for this step and for appropriate following steps in these procedures.

10-Volt Range Calibration for a Negative Input Voltage

1. Reverse the connections to the voltage standard.

2. Place the POLARITY switch in the minus (-) or AUTO position.

3. The numerical value displayed in the readout should be equal to the voltage of the voltage standard. If it is not, adjust potentiometer R1 of the Inverter Assembly (P/N 36-43) until the readout displays the correct value.

WARNING

Use extreme caution in performing the following steps as dangerously high voltages will be employed.

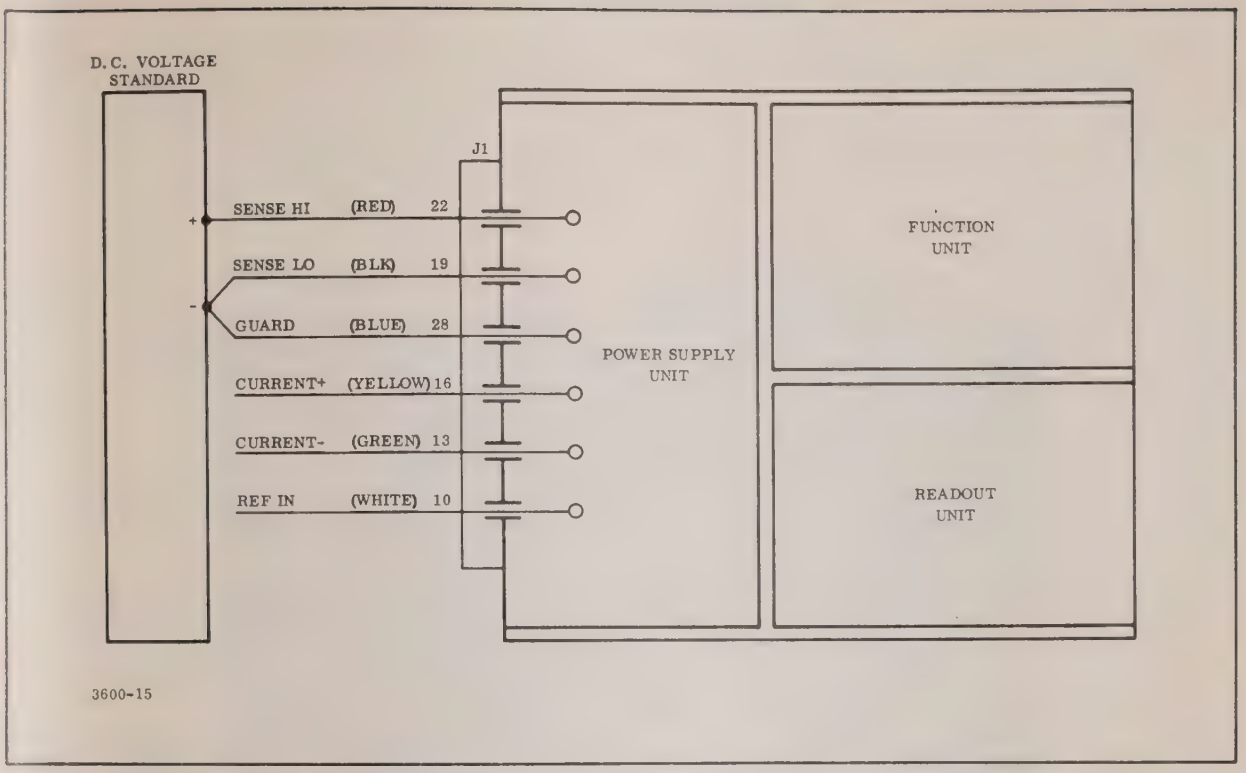


Figure 3-1. DC Volts and MV Calibration Cable Connections

100-Volt Range Calibration

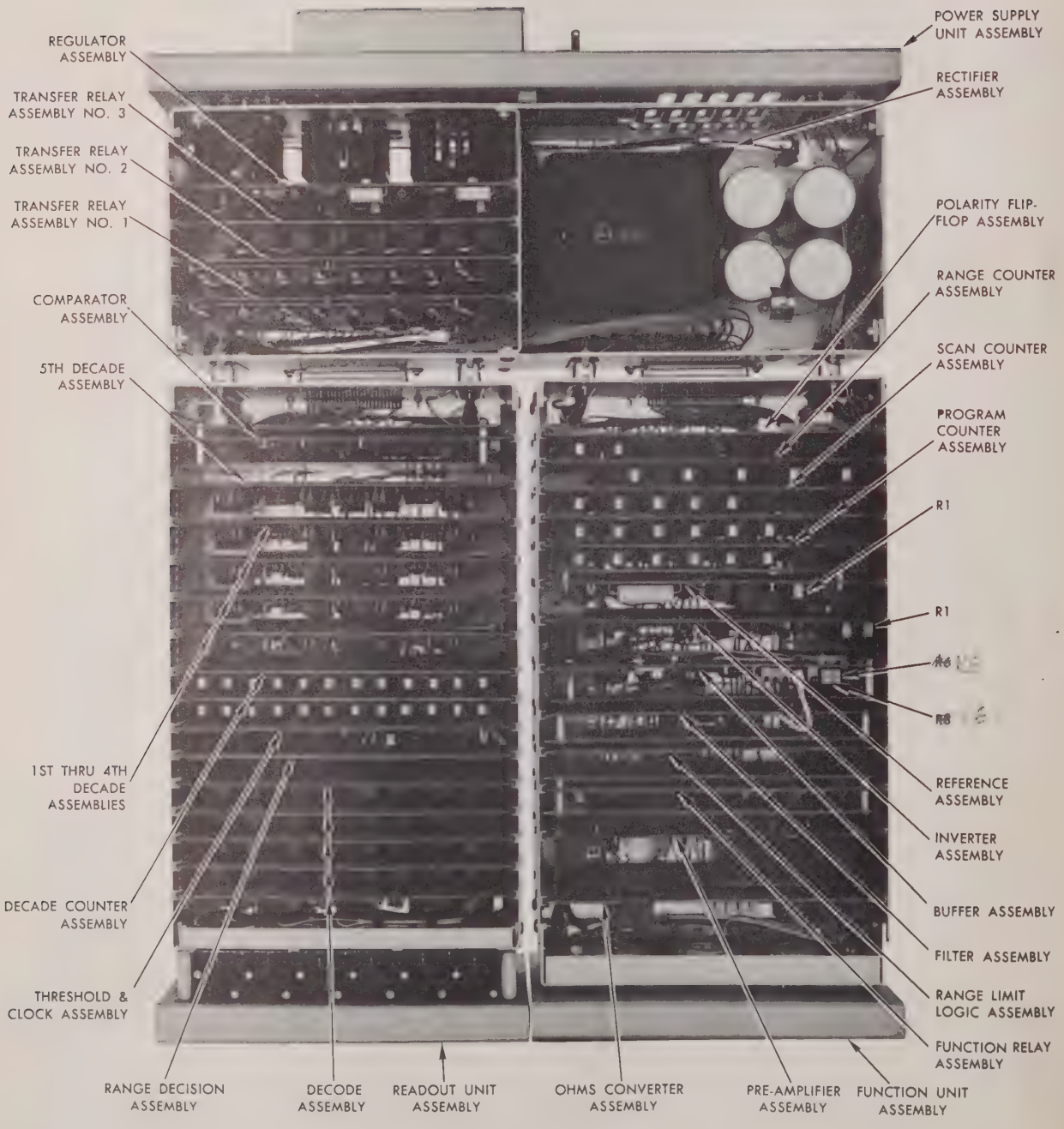
1. Place the POLARITY switch in the plus (+) or AUTO position.
2. Place the RANGE switch in the 100 position.
3. Connect the "guard" (blue) and "input low" (black) leads of the DVM input cable to the negative terminal of the voltage standard described in paragraph 2 under Equipment Required. Connect the "input high" (red) lead to the positive terminal (Figure 3-1).
4. The numerical value displayed in the readout should be equal to the voltage of the voltage standard. If it is not, adjust potentiometer R6 of the Buffer Assembly (P/N 36-314) until the readout displays the correct value.

WARNING

Use extreme caution in performing the following steps as dangerously high voltages will be employed.

1000-Volt Range Calibration

1. Ensure that the POLARITY switch remains in the plus (+) or AUTO position.
2. Place the RANGE switch in the 1000 position.
3. Connect the "guard" (blue) and "input low" (black) leads of the DVM input cable to the negative terminal of the voltage standard described in paragraph 3 under Equipment Required. Connect the "input high" (red) lead to the positive terminal (Figure 3-1).



3600-16

Figure 3-2. Location of Assemblies and DC Voltage Adjustment Points

4. The numerical value displayed in the readout should be equal to the voltage of the voltage standard. If it is not, adjust potentiometer R8 of the Buffer Assembly (P/N 36-314) until the readout displays the correct value.

Zero Offset Readjustment with DVM in Outer Chassis

1. Place the three drawers of the DVM into the outer chassis.

2. Ensure 30 minutes for instrument warm-up.

3. Perform steps 1 through 7 and note step 8 under Zero Offset Adjustments. This completes the calibration of the DVM.

RATIO CALIBRATION

ADDITIONAL EQUIPMENT REQUIRED

1. None.

INITIAL PREPARATION

1. Ensure that the instrument is properly calibrated in the DC voltage measurement function.

2. Perform steps 1 thru 3 under Initial Preparation, DC Voltage Calibration.

PROCEDURE

1. Connect the leads of the DVM as shown in Figure 3-3 to the voltage standard described in paragraph 1 under Equipment Required, DC Voltage Calibration.

2. Place the SCAN MODE switch in the INT. position.

3. Place the POLARITY switch in the negative (-) position.

4. Place the FILTER switch in the OUT position.

5. Place the FUNCTION switch in the RATIO position.

6. Turn the THRESHOLD control fully counterclockwise.

7. Place the RANGE switch in the 10 position.

8. Apply 10 volts and adjust R25 of the Ratio Reference Assembly (Figure 3-4) until the readout displays -1.00000. This step completes the calibration of the Ratio Reference Assembly.

PRE-AMPLIFIER CALIBRATION

ADDITIONAL EQUIPMENT REQUIRED

1. A voltage standard between 90.000 millivolts and 119.998 millivolts, to calibrate the 100-millivolt range.

2. A voltage standard between 900.00 millivolts and 1199.98 millivolts, to calibrate the 1000-millivolt range.

INITIAL PREPARATION

1. Ensure that the instrument is properly calibrated in DC voltage measurement function.

2. Perform steps 1 thru 3 under Initial Preparation, DC Voltage Calibration.

PROCEDURE

1. Place the SCAN MODE switch in the INT. position.

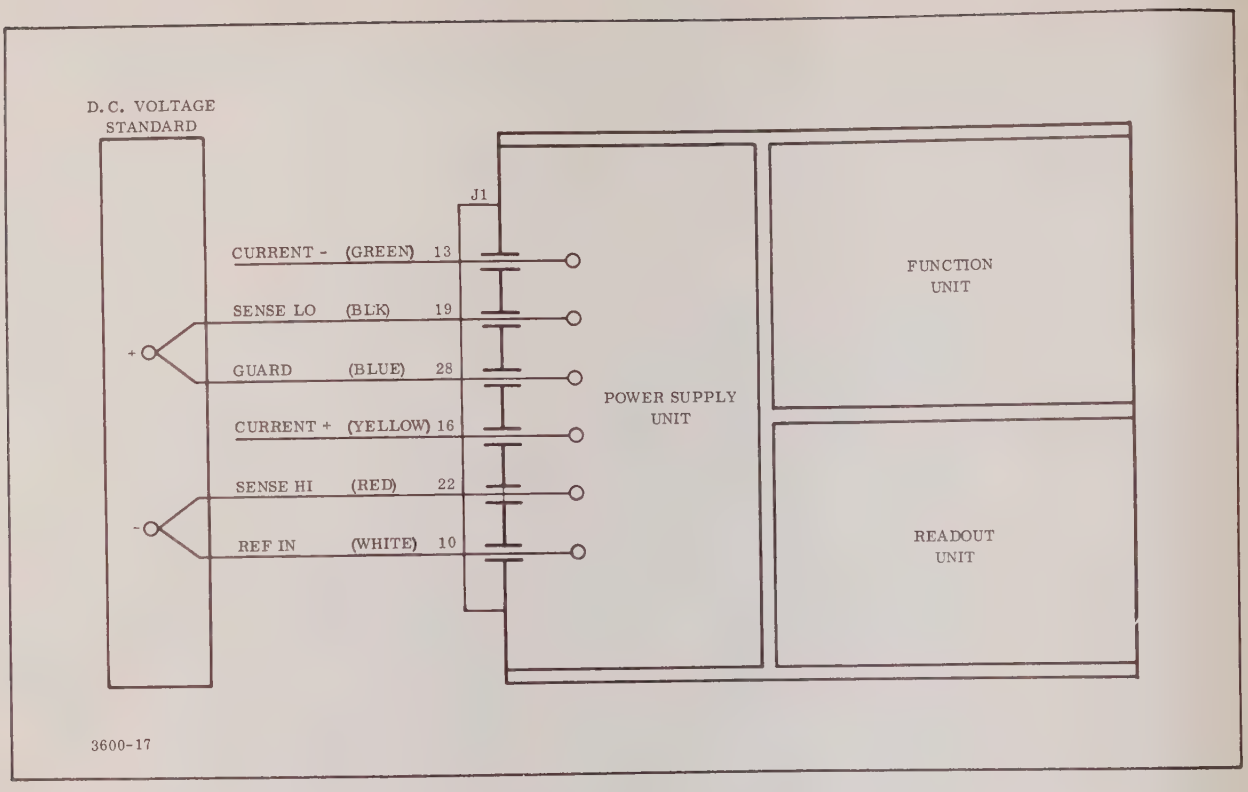


Figure 3-3. Ratio Reference Assembly Calibration Cable Connections

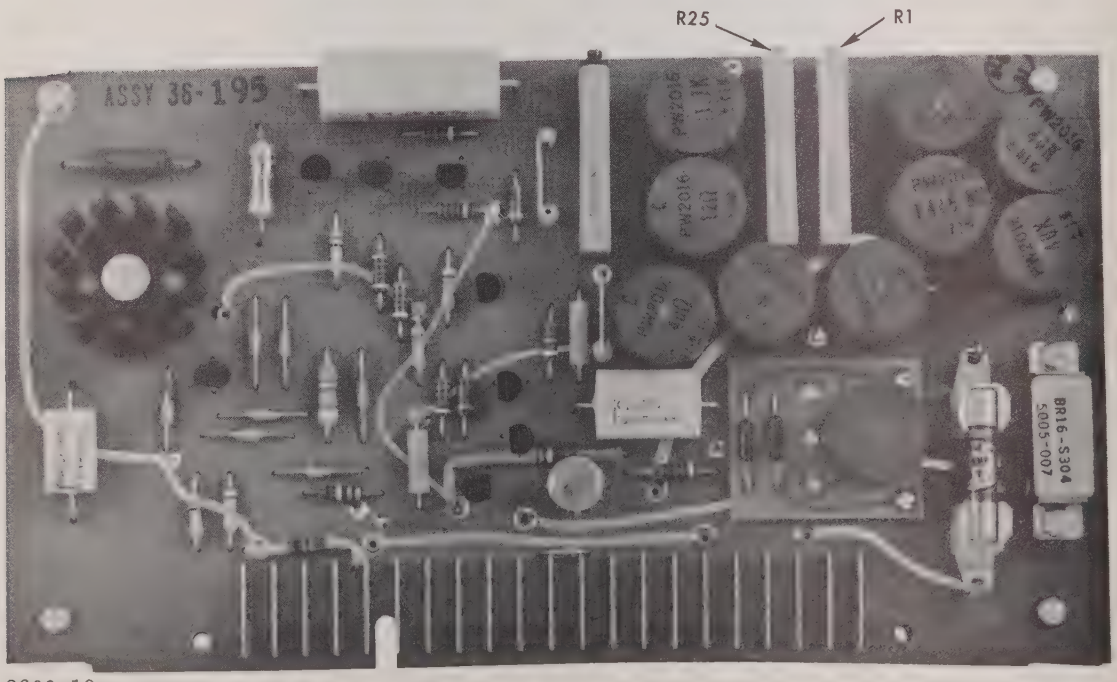


Figure 3-4. Ratio Reference Assembly Adjustment Points

2. Place the THRESHOLD control in the fully counterclockwise position.

3. Place the RANGE switch in the 100 MV position.

4. If the Pre-Amplifier Assembly is inserted into J13 of the Function Unit Assembly, place the FUNCTION switch in the most counterclockwise position. If the Pre-Amplifier Assembly is inserted into J12 of the Function Unit Assembly, place the FUNCTION switch in the secondmost counterclockwise position. (If installation of the Pre-Amplifier Assembly and MV offset knob has been properly performed, the correct offset knob will be labeled MV and the line from the offset knob to the function switch will indicate the correct position for the FUNCTION switch.)

5. Place the polarity switch in the AUTO position.

6. Place the FILTER switch in the OUT position.

7. Connect the red, black and blue leads of the DVM input cable together. Rotate the MV OFFSET knob until the readout displays 000.000.

8. Connect the input leads of the DVM input cable as shown in Figure 3-1 to the voltage standard described in paragraph 1 under Additional Equipment Required.

9. Apply approximately 95.000 millivolts and adjust R1 of the Pre-Amplifier Assembly (Figure 3-5) until the numerical value displayed in the readout is equal to the voltage of the voltage standard.

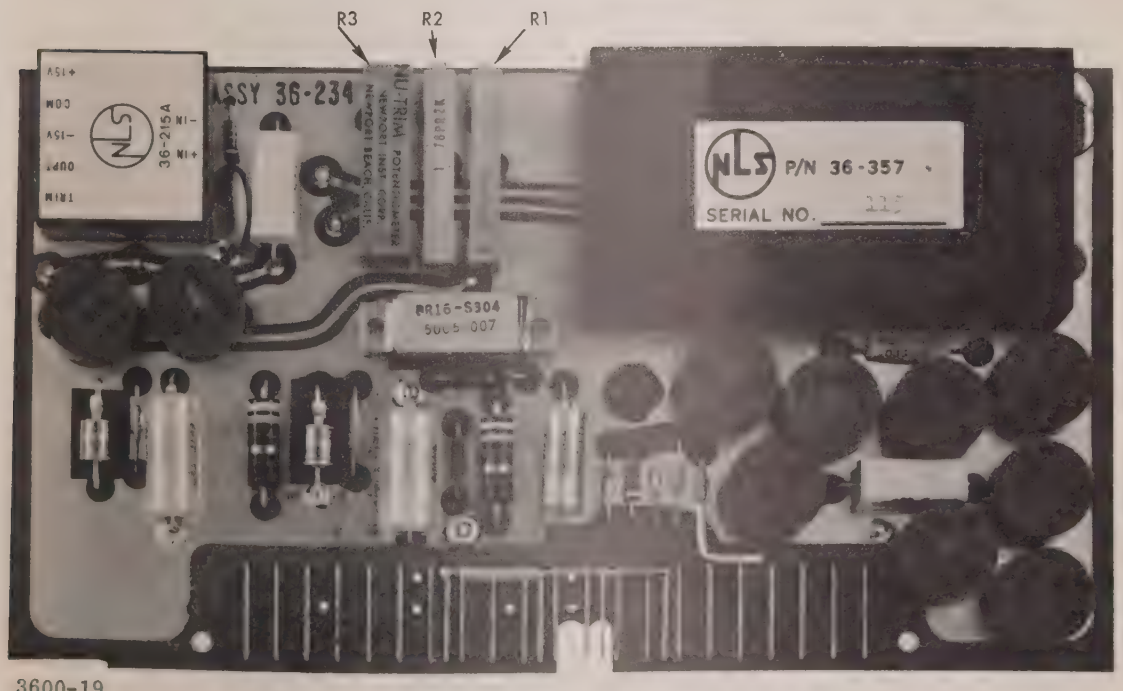


Figure 3-5. Pre-Amplifier Assembly Adjustment Points

10. Connect the leads of the DVM input cable as shown in Figure 3-1 to the voltage standard described in paragraph 2 under Additional Equipment Required.

11. Place RANGE switch in the 1000 position. Apply approximately 950,000 millivolts and adjust R2 of the Pre-Amplifier Assembly (Figure 3-5) until the numerical value displayed in the readout is equal to the voltage of the voltage standard. This step completes the calibration of the Pre-Amplifier Assembly.

OHMS CONVERTER CALIBRATION

ADDITIONAL EQUIPMENT REQUIRED

1. An ohms standard accurate to 0.01%. The values required are called out in each calibrating step.

INITIAL PREPARATION

1. Ensure that the instrument is properly calibrated in the DC voltage measurement function.

2. Perform steps 1 thru 3 under Initial Preparation, DC Voltage Calibration.

PROCEDURE

1. Place the SCAN MODE switch in the INT. position.

2. Place the THRESHOLD control in the fully counterclockwise position.

3. Place the FUNCTION switch in the most counterclockwise position.

4. Place the FILTER switch in the OUT position.

5. Place the RANGE switch in 1K range.

NOTE

The 1K range is displayed on the front panel as the numeral 1 since the ohms ranges are in KΩ. Also, the numerals 10 and 100 represent the 10K and 100K ranges respectively and the 1000 and 10000 displays represent the 1 MEG and 10 MEG ranges respectively.

6. Connect the red, yellow, blue, black and green leads of the DVM together. Adjust the KΩ OFFSET control until the readout displays 00.0000.

7. Connect the leads of the DVM input cable to the ohms standard as shown in Figure 3-6.

8. Apply approximately .90000 KΩ and adjust R1 of the Ohms Converter Assembly (Figure 3-7) until the numerical value displayed in the readout is equal to the ohmic value applied.

9. Place RANGE switch in the 10K range. Apply approximately 9.0000 KΩ and adjust R2 of the Ohms Converter Assembly (Figure 3-7) until the numerical value displayed in the readout is equal to the ohmic value applied.

10. Place RANGE switch in the 100K range. Apply approximately 90.000 KΩ and adjust R3 of the Ohms Converter Assembly (Figure 3-7) until the numerical value displayed in the readout is equal to the ohmic value applied.

11. Place RANGE switch in the 1 MEG range. Apply approximately 900.00 KΩ and adjust R4 of the Ohms Converter Assembly (Figure 3-7) until the numerical value displayed in the readout is equal to the ohmic value applied.

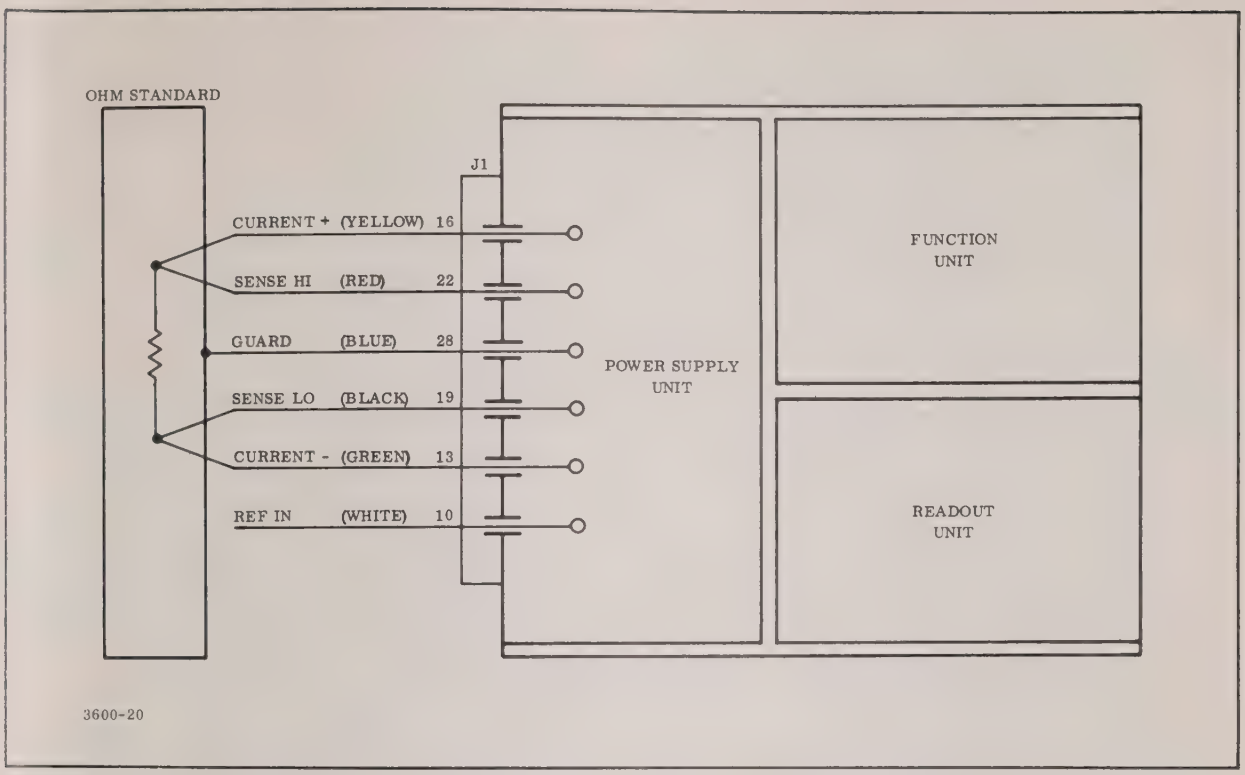


Figure 3-6. Ohms Converter Assembly Calibration Cable Connections

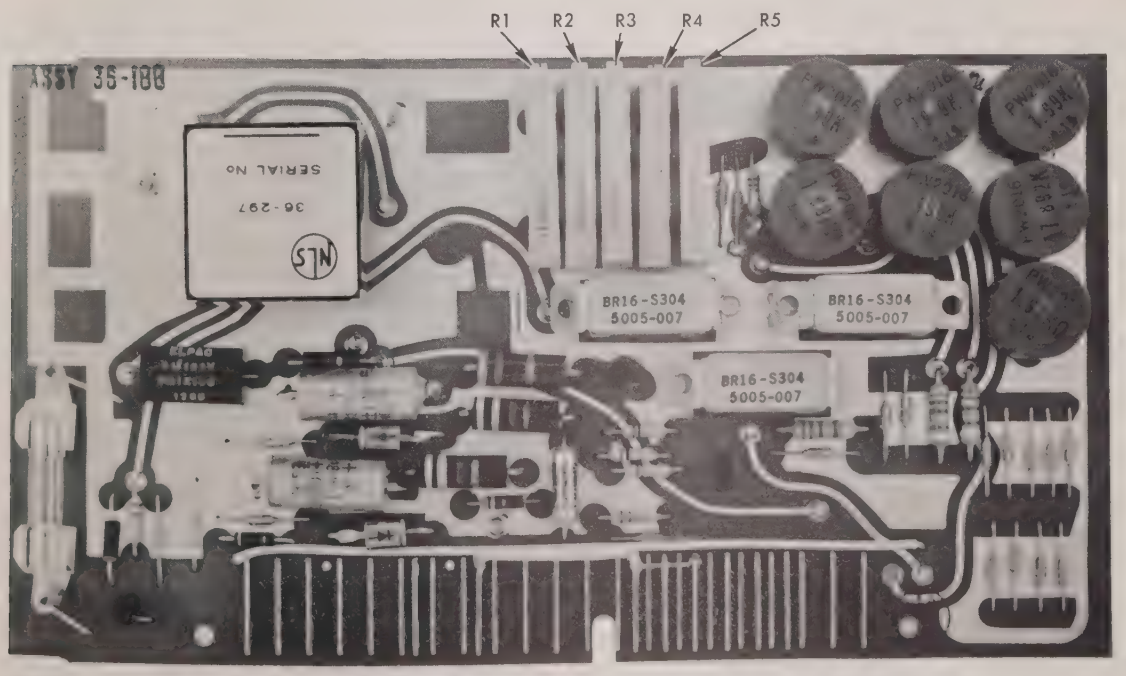


Figure 3-7. Ohms Converter Adjustment Points

12. Place RANGE switch in the 10 MEG range. Apply approximately 9000. 0KΩ and adjust R5 of the Ohms Converter Assembly (Figure 3-7) until the numerical value displayed in the readout is equal to the ohmic value applied.

NOTE

When measuring high value resistors, it may be necessary to connect the guard (blue lead) to earth ground and/or turn the filter switch to the IN position.

Step 12 completes the calibration of the Ohms Converter Assembly.

AC CONVERTER CALIBRATION

ADDITIONAL EQUIPMENT REQUIRED

1. An Audio Voltage Standard between 1 volt, 200 Hz - 10 KHz and 500 volts, 200 Hz - 10 KHz.

INITIAL PREPARATION

1. Ensure that the instrument is properly calibrated in the DC voltage measurement function.

2. Perform steps 1 thru 3 under Initial Preparation, DC Voltage Calibration.

PROCEDURE

1. Place the SCAN MODE switch in the INT. position.

2. Place the FUNCTION switch in the secondmost counterclockwise position.

3. Place the FILTER switch in the OUT position.

4. Place the RANGE switch in the 1 position.

5. Turn the THRESHOLD control fully counterclockwise.

6. Connect the red, black and blue leads of the DVM input cable together. Adjust the AC OFFSET control until the readout displays 00. 0000.

7. Connect the leads of the DVM input cable to the audio voltage standard as shown in Figure 3-8.

8. Apply approximately .90000 volts, 200 Hz and adjust R4 of the AC Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the voltage applied.

9. Apply approximately .90000 volts, 10 KHz and adjust C4 of the AC Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the voltage applied.

10. Place the RANGE switch in the 10 position. Apply approximately 9. 0000 volts, 200 Hz and adjust R3 of the AC Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the voltage applied.

11. Apply approximately 9. 0000 volts, 10 KHz and adjust C3 of the AC Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the voltage applied.

WARNING

Use extreme caution in performing the following steps as dangerously high voltages will be employed.

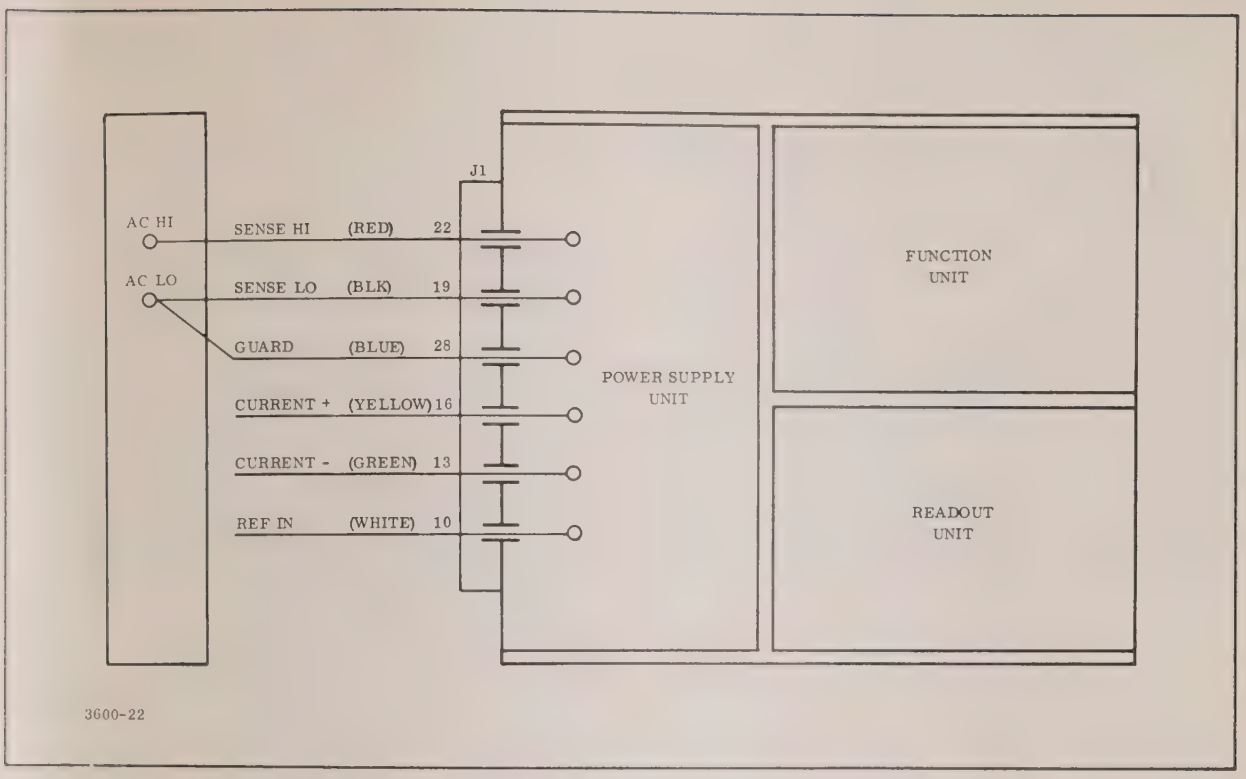


Figure 3-8. AC Converter Assembly Calibration Cable Connections

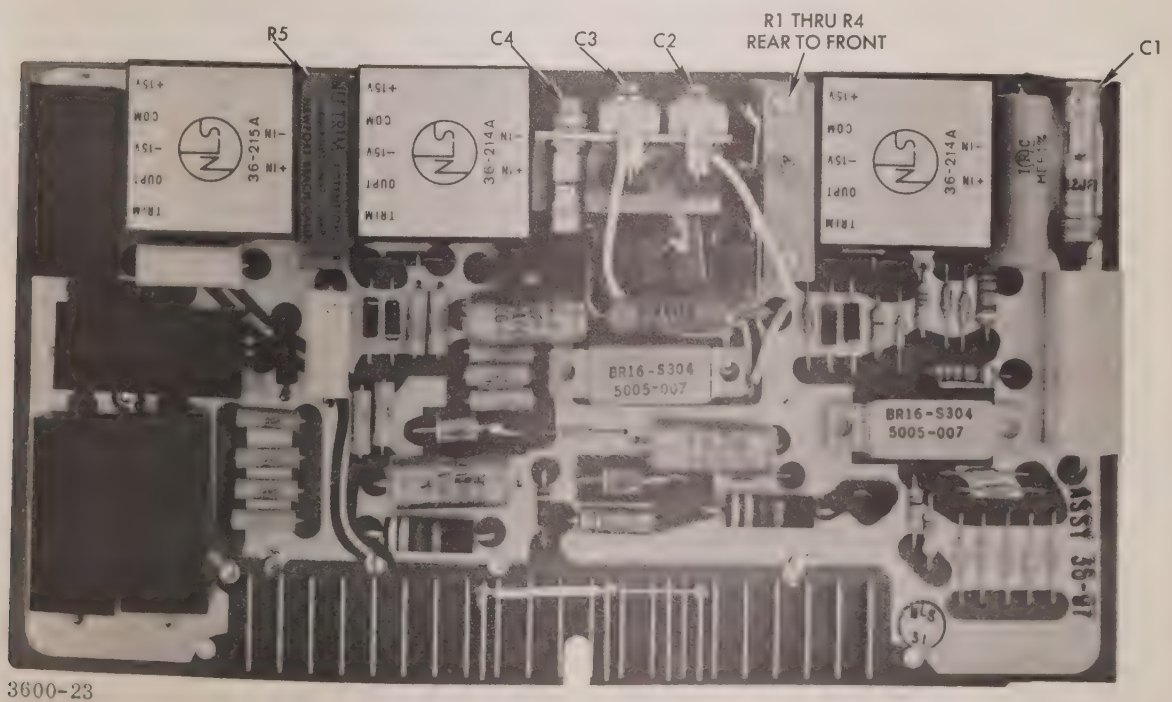


Figure 3-9. AC Converter Adjustment Points

12. Place the RANGE switch in the 100 position. Apply approximately 90.000 volts, 200 Hz and adjust R2 of the AC Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the voltage applied.

13. Apply approximately 90.000 volts, 10 KHz and adjust C2 of the AC Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the voltage applied.

CAUTION

Do not apply more than 500 VAC - damage to the AC Converter Assembly may result.

14. Place the RANGE switch in the 1000 position. Apply approximately 450.000 volts, 200 Hz and adjust R1 of the AC Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the voltage applied.

15. Apply approximately 450.00 volts, 10 KHz and adjust C1 of the AC Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the voltage applied. This step completes the calibration of the AC Converter Assembly.

CHAPTER IV

MAINTENANCE

In the Series X-1 Digital Voltmeter, virtually all circuit components are assembled on plug-in modules. Thus maintenance problems are simplified to the point where the instrument can be kept operating without the need for highly trained maintenance personnel. Because of this plug-in design, down-time is held to a minimum; the unit can be kept operating in locations from which it would be impractical or inconvenient to send the instrument to a repair facility or to the manufacturer. Only a very few minutes are needed to replace all of the plug-in boards. By using trial-and-error techniques the instrument can be rapidly returned to service, and the defective module repaired at a later date.

For a general understanding of the principles of operation of the Series X-1 DVM, refer to Figures 4-1 thru 4-11. For a more detailed analysis, refer to the Schematic and wiring diagrams at the end of this manual.

In order to pursue the plug-in philosophy to the fullest, spare modules as listed in Section V, Recommended Spare Parts List, should be kept for each instrument.

If it is desired to measure voltages and check waveforms on a particular plug-in module, a 41-pin extension board will be required to raise the board so that pin contacts become accessible. These boards, NLS part number 1009-41, may be ordered from any NLS representative or from the NLS Main Office in Del Mar, California.

DIGITAL READOUT MAINTENANCE

The digital readout modules do not ordinarily require maintenance other than lamp bulb replacement and an occasional cleaning. Most readouts have decals on the module cover, on the top and bottom of each readout, to show which contact is providing the signal for each digit or symbol. If decals are not provided, see Figure 4-12 for information to locate each digit or symbol contact point.

LAMP BULB REPLACEMENT

When it is determined that a digit or symbol is not illuminating within a specific readout display, the lamp bulb may be replaced by performing the following steps:

1. Remove the knobs from the readout panel.

CAUTION

Do not disconnect drawer assemblies with power on. Damage to plug-in modules may result.

2. Loosen (turn counterclockwise) the two fasteners on the Readout Unit Assembly.

3. Pull drawer slightly forward and then remove four screws attaching readout panel to readout drawer assembly and remove front panel.

4. Gently withdraw readout module with defective bulb from readout plug-in board (Figure 4-13).

5. Locate correct contact point for defective bulb either by noting decal on readout or by referring to Figure 4-12.

6. Remove cover from readout by removing the two attaching screws (Figure 4-14).

7. Gently withdraw the lamp board assembly away from the lamp block within the readout (Figure 4-15).

8. Unsolder defective bulb and replace it with a functioning T-1-3/4 14-volt bulb. (screw 10) TRW's (10-1705)

9. Reassemble readout and replace readout, filter, front panel and knobs in reverse order of removal.

10. If for any reason the Polaroid filter is removed from between the control identification panel and the facade, care should be taken to re-install the filter so that the polarizing action is correct. Look through the filter at a piece of shiny metal, such as the chrome rim of a wrist-watch. If the metal shows a markedly violet cast, then the filter front is the surface closest to the eye.

READOUT WINDOW CLEANING

Under extremely adverse dust or humidity conditions, the individual readout windows may require cleaning. If accumulated dust particles are likely to be unusually abrasive, a camel-hair brush or artist's sable brush should first be used to remove loose dust particles. The windows may then be cleaned with commercial isopropyl alcohol and lint-free paper, such as Kimwipes 900-L, manufactured by Kimberly-Clark, Neenah, Wisconsin. The windows may also be cleaned if they are dipped in alcohol and then blown dry with compressed air.

To remove the windows from the readout, perform the following steps:

1. Perform steps 1, 2, and 3 under Lamp Bulb Replacement.

2. Perform steps 5 and 6 (both top and bottom lamp boards) under Lamp Bulb Replacement for each readout to be cleaned.

3. Remove each two sets of lamp block attaching screws.

4. Gently press against one lamp block until the other lamp block may be removed and until windows can be withdrawn with finger-tip pressure.

5. Clean the windows as set forth above.

NOTE

It is well to be systematic about this operation so as to avoid replacing the windows in improper order. Care should be taken to avoid replacing the windows backwards; this type of error is most likely to occur with windows marked 1, 0, 6, 8, 9, + or -. Note that the engraved side always faces to the rear of the readout.

6. Stack the windows in proper order and press them together with mild fingertip pressure. Avoid fingerprints on the windows. After ensuring that the numerals are right side up and that the engraved side faces the rear of the readout, gently slip the windows into the cover.

7. Perform step 9 and note step 10 under Lamp Bulb Replacement.

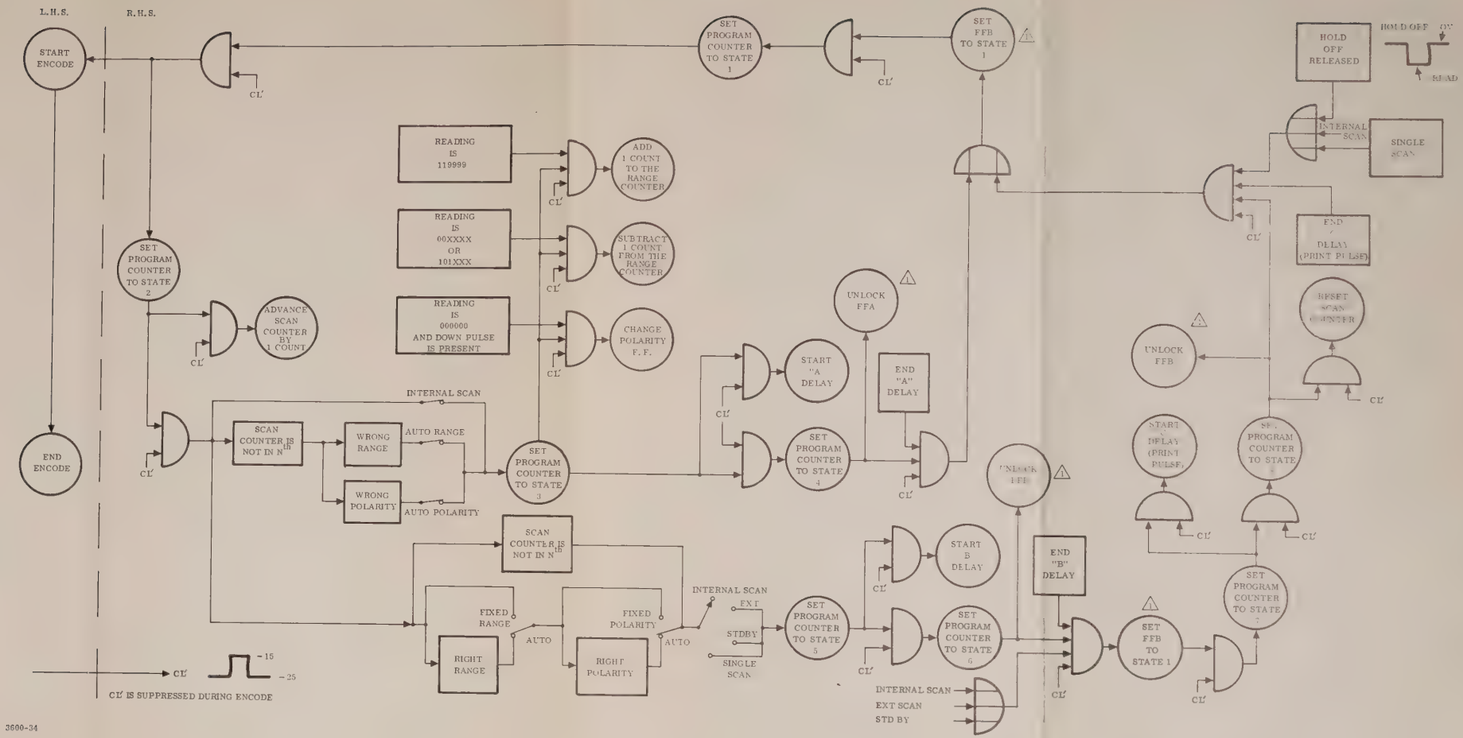
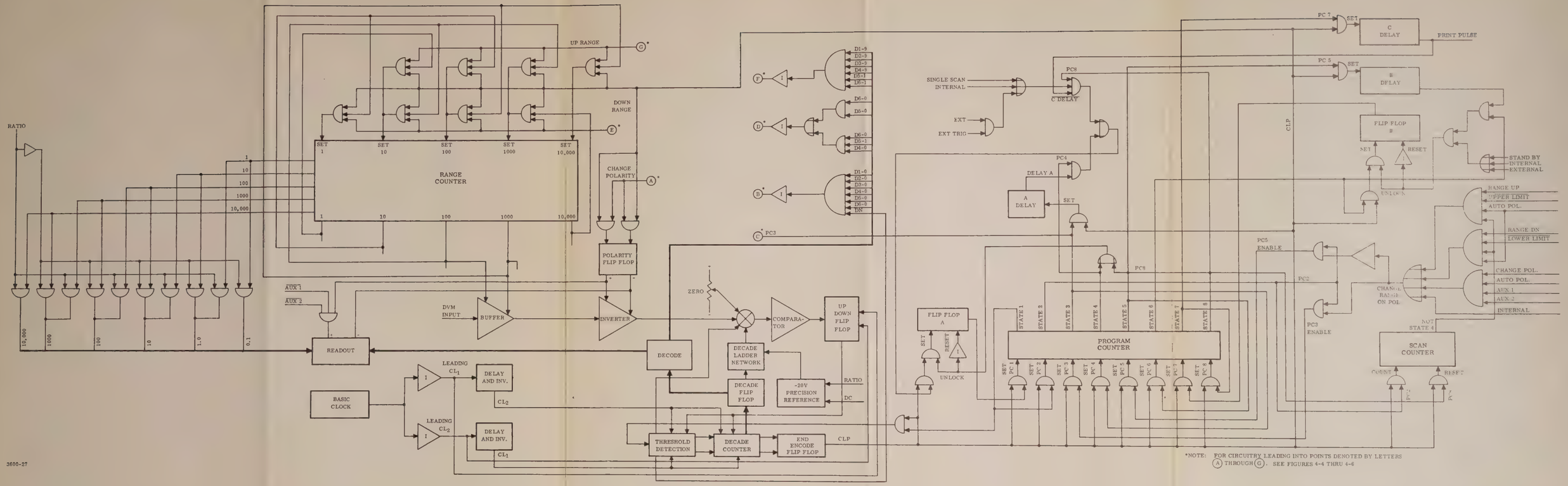
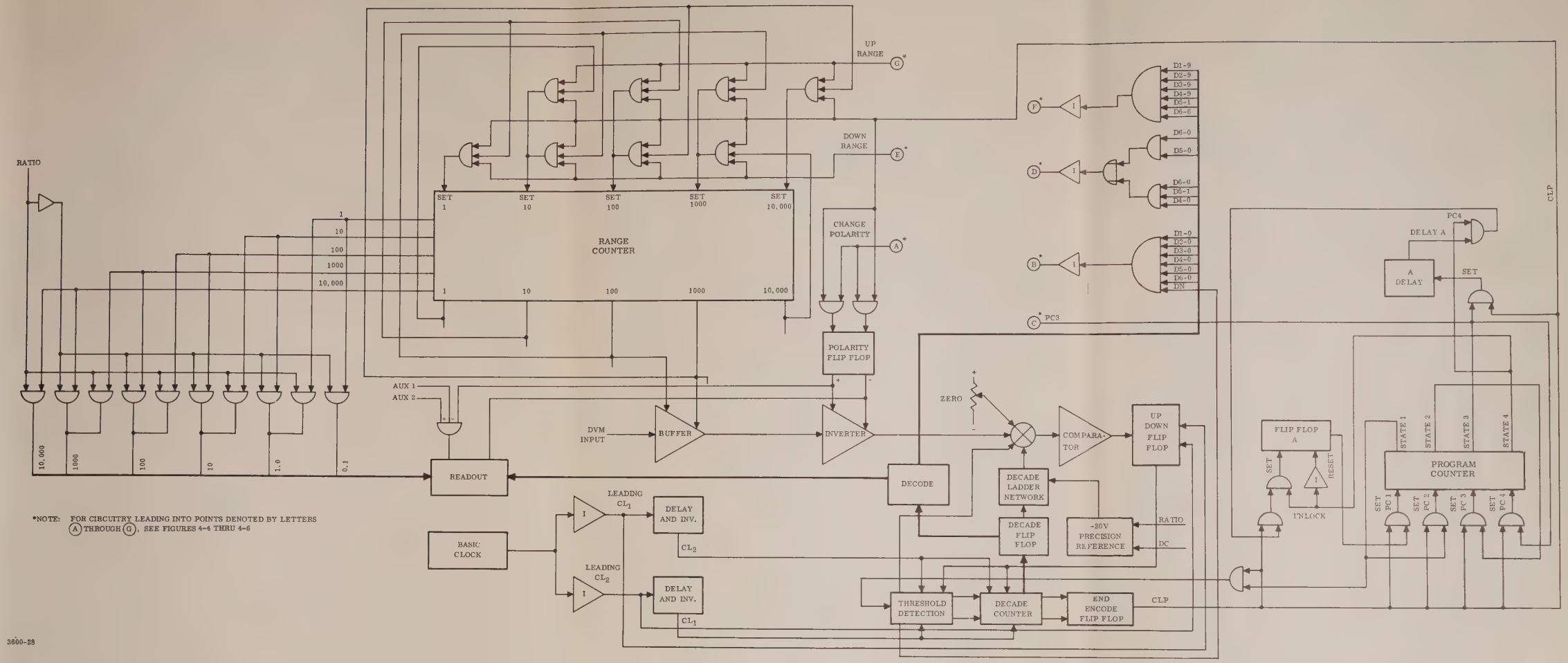


Figure 4-1. Series X-1 DVM Flow Diagram



*NOTE: FOR CIRCUITRY LEADING INTO POINTS DENOTED BY LETTERS (A) THROUGH (G). SEE FIGURES 4-4 THRU 4-6

Figure 4-2. Block Diagram X-1 DVM with Printout Function



*NOTE: FOR CIRCUITRY LEADING INTO POINTS DENOTED BY LETTERS (A) THROUGH (G), SEE FIGURES 4-4 THRU 4-6

3600-28

Figure 4-3. Block Diagram X-1 DVM without Printout Function

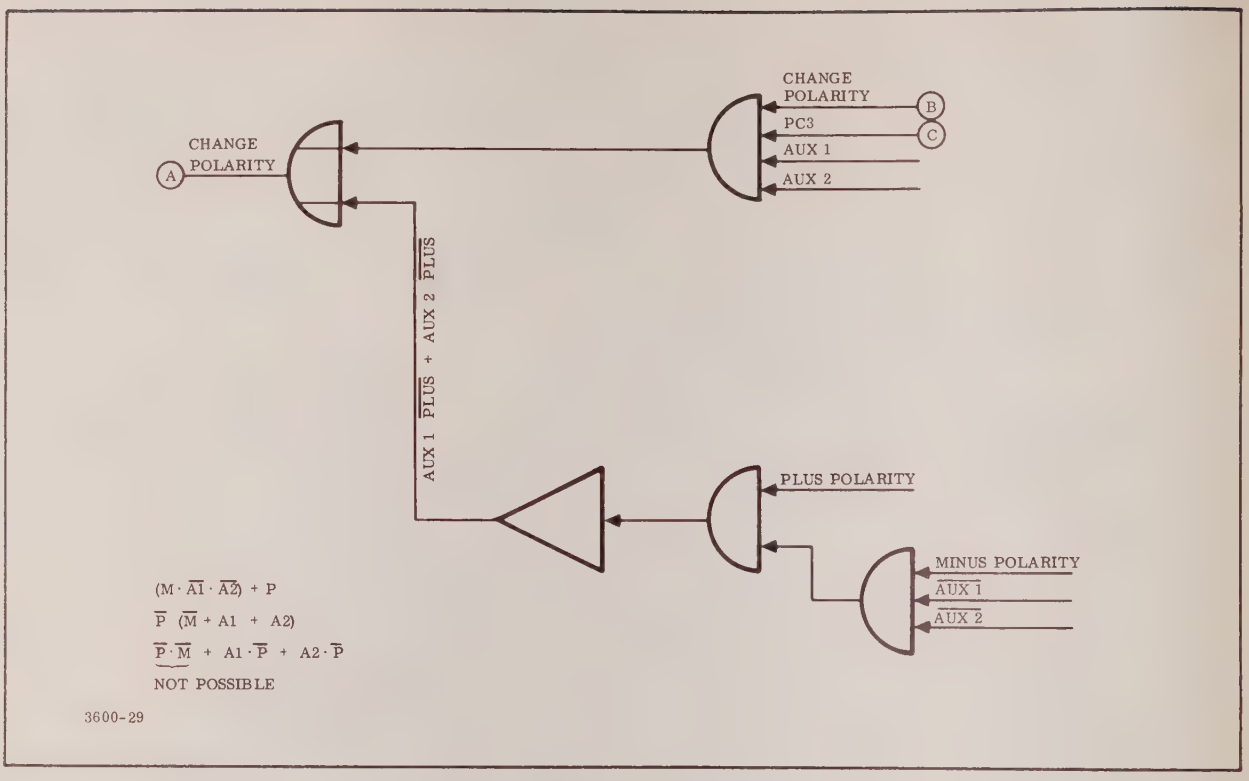


Figure 4-4. Polarity Gate

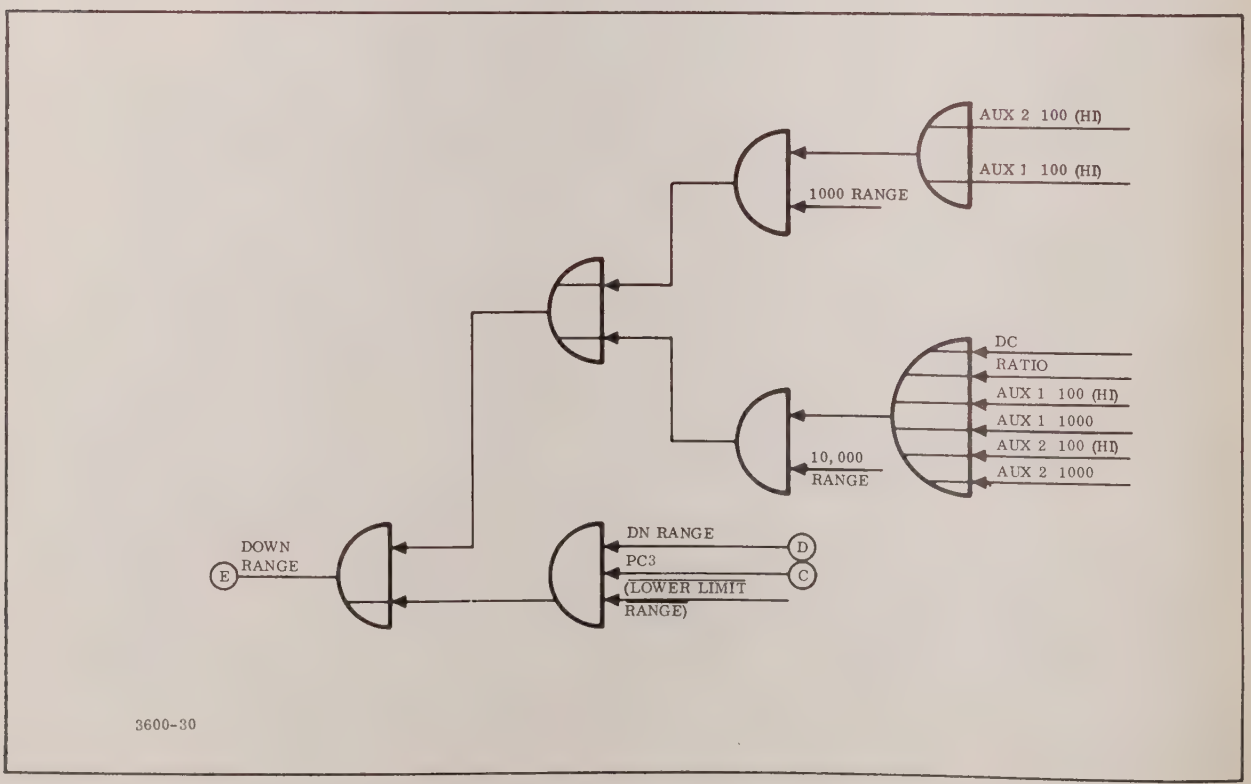


Figure 4-5. Forbidden Upper Range Gate

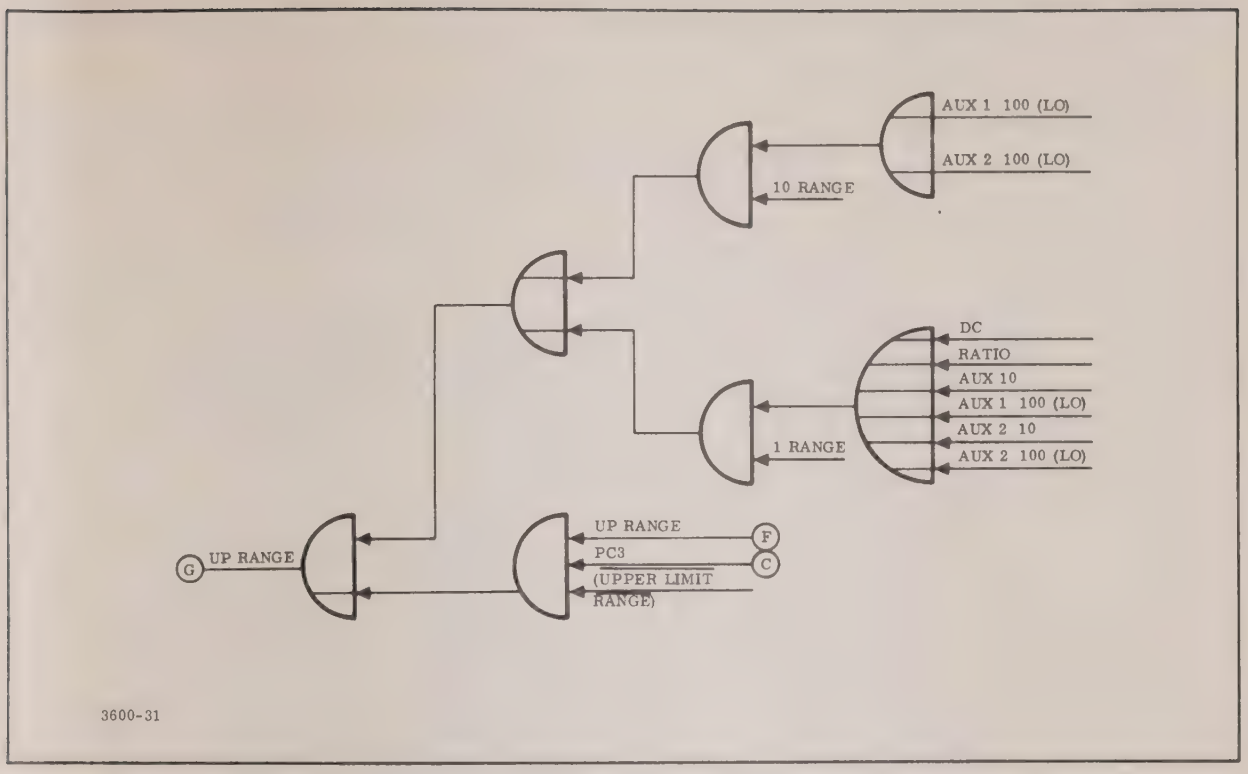


Figure 4-6. Forbidden Lower Range Gate

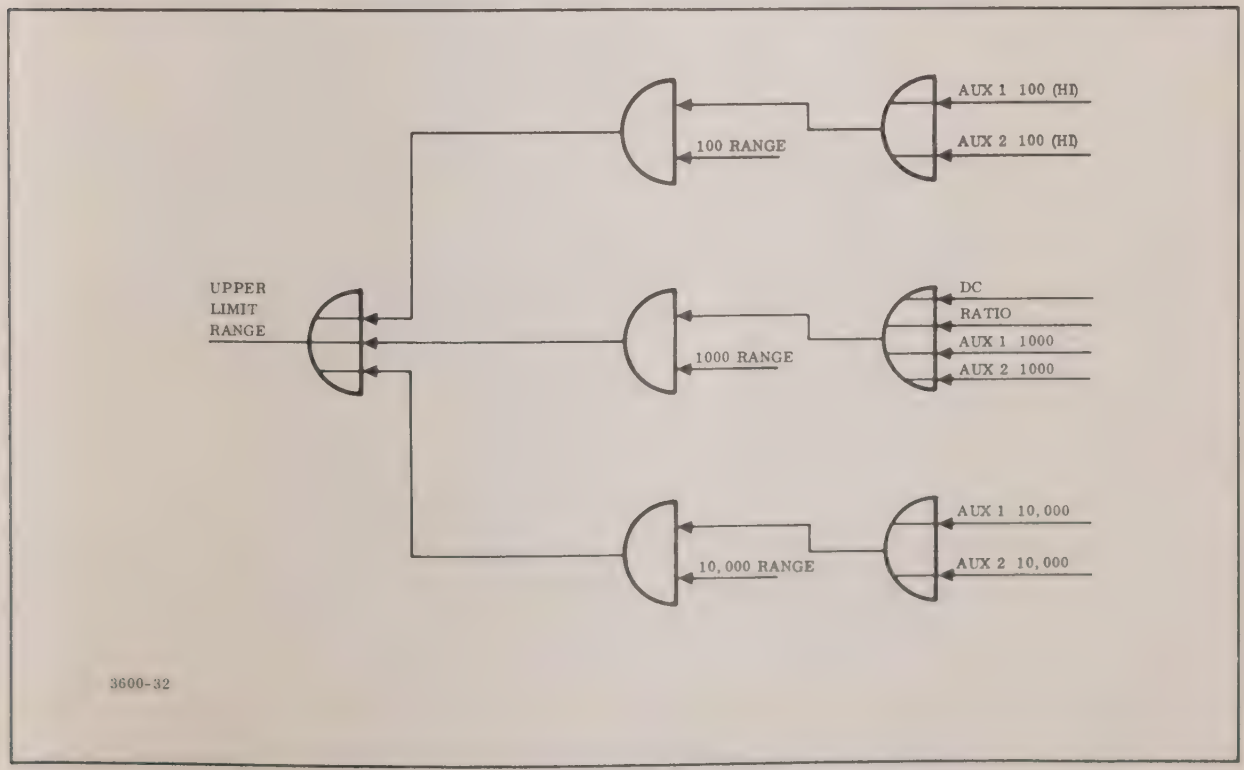


Figure 4-7. Upper Limit Range Gate

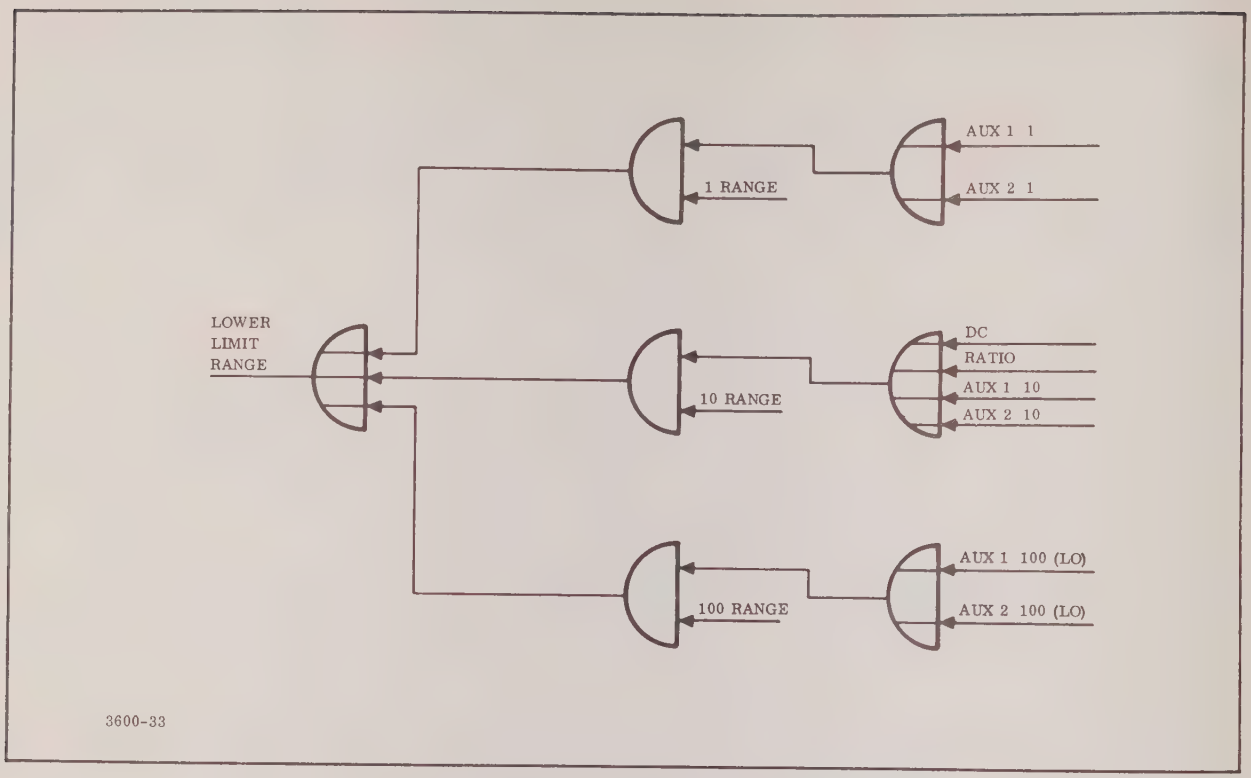


Figure 4-8. Lower Limit Range

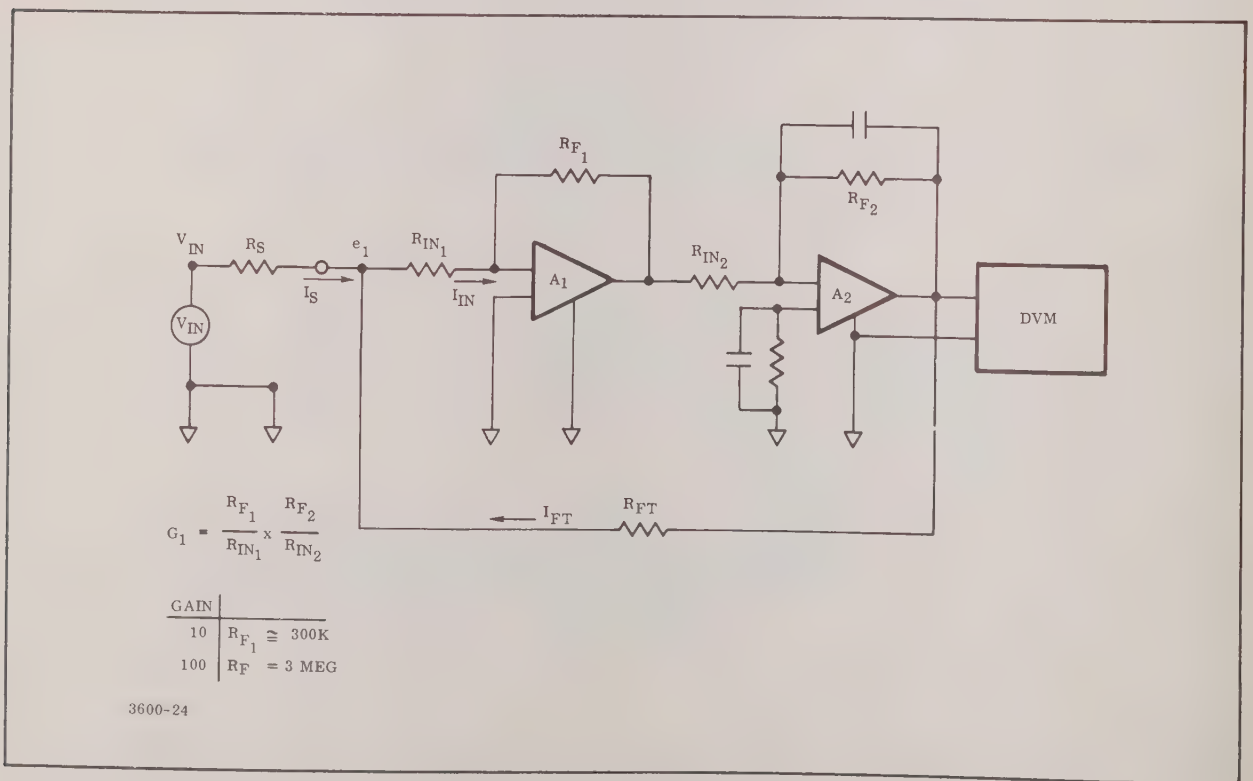
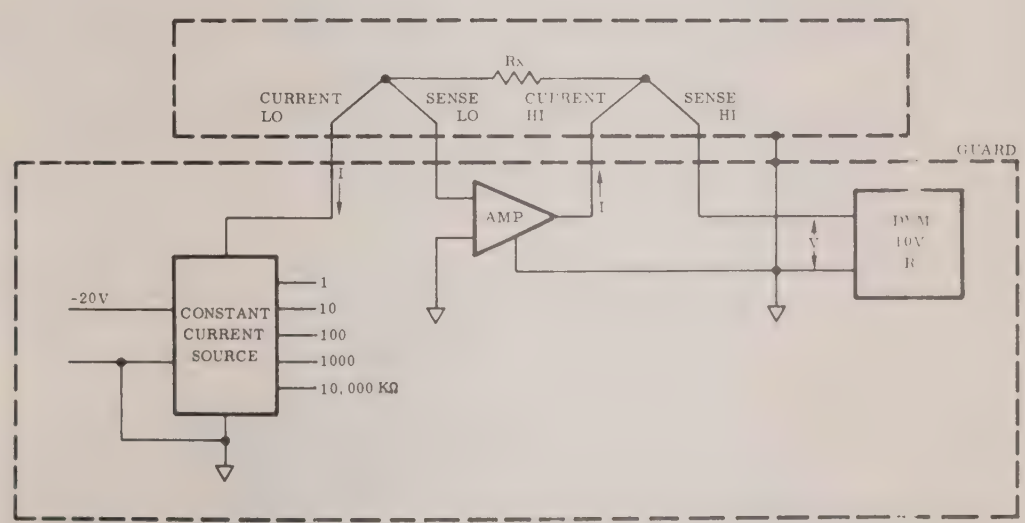


Figure 4-9. Simplified Diagram Pre-Amplifier Assembly



$V = I\ R_X$ (FULL SCALE) = 10 VOLTS

R_X	I
1K	10MA
10K	1MA
100K	100μA
1000K	10μA
10,000K	1μA

3600-25

Figure 4-10. Simplified Diagram Ohms Converter Assembly

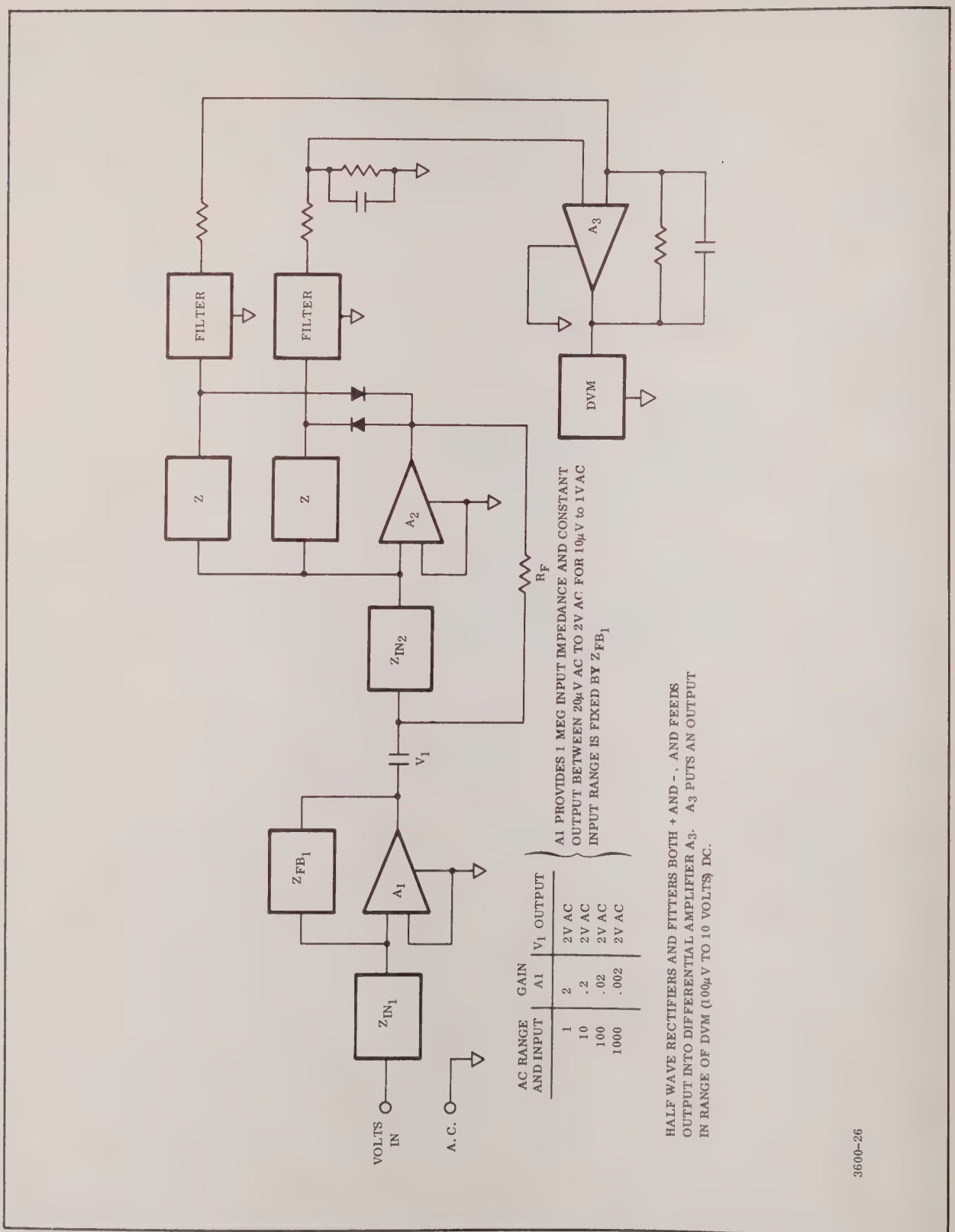


Figure 4-11. Simplified Diagram AC Converter Assembly

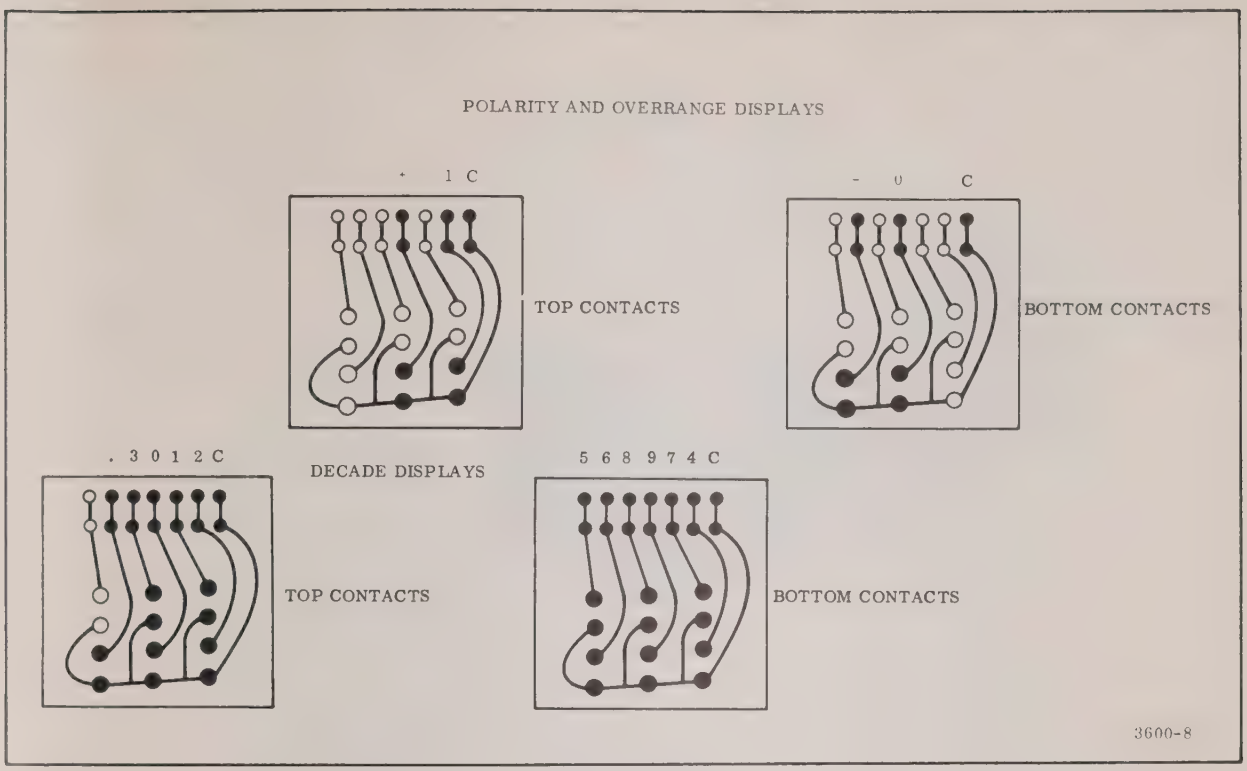


Figure 4-12. Lamp Bulb Contact Points

Figure 4-13. Readout Module Removal

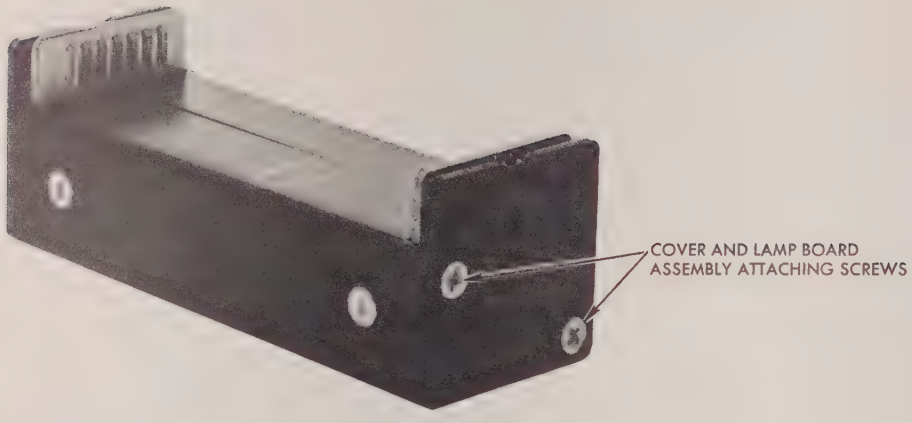


Figure 4-14. Readout Module

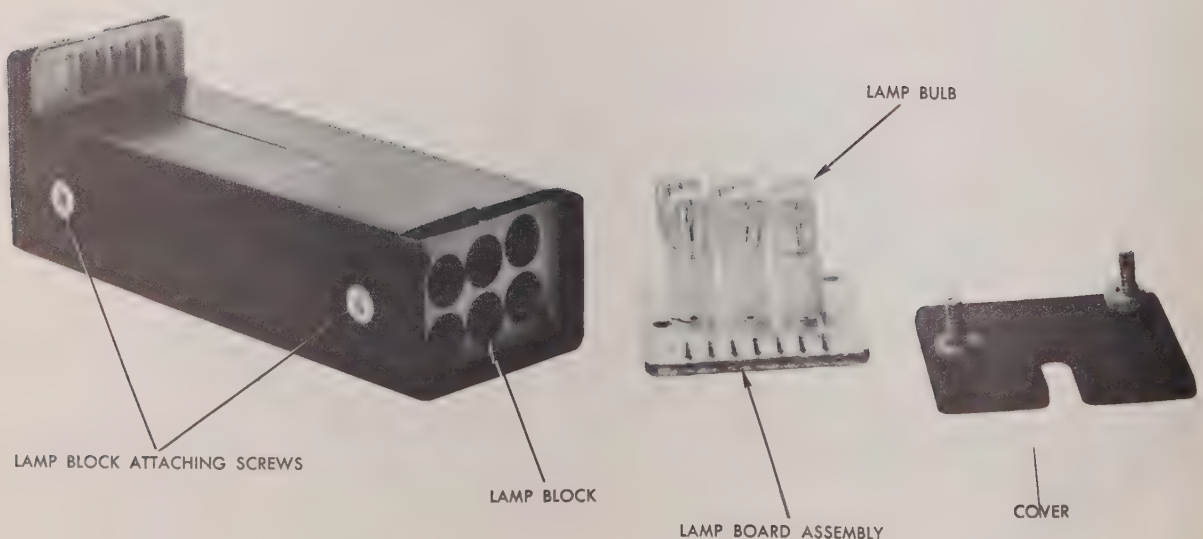


Figure 4-15. Readout Module with Cover and Lamp Board Assembly Removed

CHAPTER V

RECOMMENDED SPARE PARTS LIST

PART NO.	DESCRIPTION	QUANTITY
36-8	Decade Counter Assembly	1
36-11	Reference Assembly	1
36-14	Decade (1-4) Assembly	1
36-16	Decade (5) Assembly	1
36-26	Comparator Assembly	1
36-43	Inverter Assembly	1
36-55	Rectifier Assembly	1
36-67	Decode Assembly	1
36-73	Threshold and Clock Assembly	1
36-179	Transfer Board No. 1 Assembly (DVM P/N 36-218 only)	1
36-182	Transfer Board No. 2 Assembly (DVM P/N 36-218 only)	1
36-185	Transfer Board No. 3 Assembly	1
36-191	Function Relay Assembly	1
36-249	Program Counter Assembly	1
36-266	Regulator Assembly	1
36-269	Polarity Flip-Flop Assembly	1
36-272	Range Counter Assembly	1
36-275	Scan Counter Assembly (DVM P/N 36-218 only)	1
36-296	Filter Assembly	1
36-314	Buffer Assembly	1
36-320	Range Limit Logic Assembly	1
36-324	Range Decision Assembly	1
1N4720	Diode	1
4-10-59	Readout Module (Decade)	1
4-10-98	Readout Module (Polarity and Over-range)	1
4-19-1	Bulb, Lamp	12
313001	Fuse, 3AG1A, Slo-Blo	10
WHISPER	Fan, Rotron	1
1009-41	Extension Board	1
D-224	Transformer	1
500-1034-01	Capacitor, 6000 MFD, 20V	1
500-1058-01	Capacitor, 1900 MFD, 50V	1
500-1074-01	Capacitor, 725 MFD, 100V	1

APPENDIX

SHIPPING INSTRUCTIONS

Depending upon location, the choice of carrier will vary. Never ship an instrument to us without having received shipping instructions. If requested, an estimate of charges can be made before work begins.

Be certain to pack the instrument carefully; while an outer and inner box, separated by two or three inches of excelsior is desirable, the instrument can be placed into a single container provided it is so packed that it will not shift about. As with the double box method, use two or three inches of shock-absorbent packing materials. The instrument itself should be first wrapped in heavy paper so as to keep excelsior or other particles from entering the instrument's louvers. If the original shipping container is in good condition, it may be used.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it does not operate or is damaged, a claim should be made with the carrier. The claim agent should receive a full report of damage, and this report sent to Non-Linear Systems, Inc. After receiving such a report we will advise you of the disposition of the instrument and arrange for its repair or replacement. Be certain to include model and serial number when corresponding.

GLOSSARY OF FUNCTION DESIGNATIONS ON SCHEMATIC DIAGRAMS

Decade Counter Assembly - 36-8

(D) (CL2) - Down signal and clock pulse
$CL1_2$ - Clock pulse
$CL2_1$ - Clock pulse
Z DECS - Zero decades
(D) (CL1) - Down signal and clock pulse
$CL1_1$ - Clock pulse
Z 5-4 - Zero the 4 bit in the 5th Decade (Typical)
S 5-4* - Set the 4* bit in the 5th Decade (Typical)
$CL2_2$ - Clock pulse

Comparator Assembly - 36-26

(D) CL1 - Down signal and clock pulse
(D) CL2 - Down signal and clock pulse
D. A. C. - Digital-to-analog converter

Inverter Assembly - 36-43

L = MINUS - Low signal is minus polarity
L = PLUS - Low signal is plus polarity

Decode Assembly - 36-67

L = 1 - Low signal = 1 bit
H = 1 - High signal = 1 bit
L = 2• 2* (4*) - Low signal = 2 & 2* bit (1-4 decades) and 2 & 4* bit in 5th decade
H = 2• 4 - High signal = 2 & 4 bit

Threshold and Clock Assembly - 36-73

D-CL2 - Down signal and clock pulse
$CL2_2$ - Clock pulse
$DL2_1$ - Clock pulse
D-CL_1 - Down signal and clock pulse
$CL1_2$ - Clock pulse
$CL1_1$ - Clock pulse
CL_3 - Clock pulse
CL_2 - Clock pulse
CL_1 - Clock pulse

L = UP - Low signal = up pulse
L = DN - Low signal = down pulse
H = DN - High signal = down pulse
$\overline{\text{L = ENCODE}}$ - Low signal = not encode
L = ENCODE - Low signal = encode

Transfer Relay Assembly #1 - 36-179

D4-8 - Decade 4, numeral 8 (Typical)
P. S. G. - Power supply ground
C. C. - Contact closure

Transfer Relay Assembly #2 - 36-182

D4-8 - Decade 4, numeral 8 (Typical)
B. C. D. -4 - Binary numeral 4 (Typical)

Program Counter Assembly - 36-249

CL_P - Clock pulse to program counter

Regulator Assembly - 36-266

P. S. G. - Power supply ground

Polarity Flip-Flop Logic Assembly - 36-269

PC_7 - Program counter state 7
L = CHANGE POLARITY - Low signal = polarity change
PC_3 - Program counter state 3
H = RATIO - High signal = ratio
CL_3 - Clock pulse
L = $\overline{PC_3}$ - Signal is low with program counter in state 3

Range Counter Assembly - 36-272

CL_P - Clock pulse to program counter
H = UP RANGE - High signal is up range pulse
H = DN RANGE - High signal is down range pulse

Scan Counter Assembly - 36-275

CL_P - Clock pulse to program counter
H = AUTO RANGE - High signal = auto range
L = RANGE UP - Low signal = up range pulse

L = 1000V RANGE - Low signal = 1000V range
L = RANGE DN - Low signal = down range pulse
L = 10V RANGE - Low signal = 10V range

Range Limit Logic Assembly - 36-320

H = LOWER LIMIT RANGE - High signal = lower limit range
H = UPPER LIMIT RANGE - High signal = upper limit range
H = RANGE UP - High signal = up range pulse
H = RANGE DOWN - High signal = down range pulse
L = RANGE UP - Low signal = up range pulse
L = PC_3 - Signal is low with program counter in state 3
L = DOWN RANGE - Low signal = down range pulse

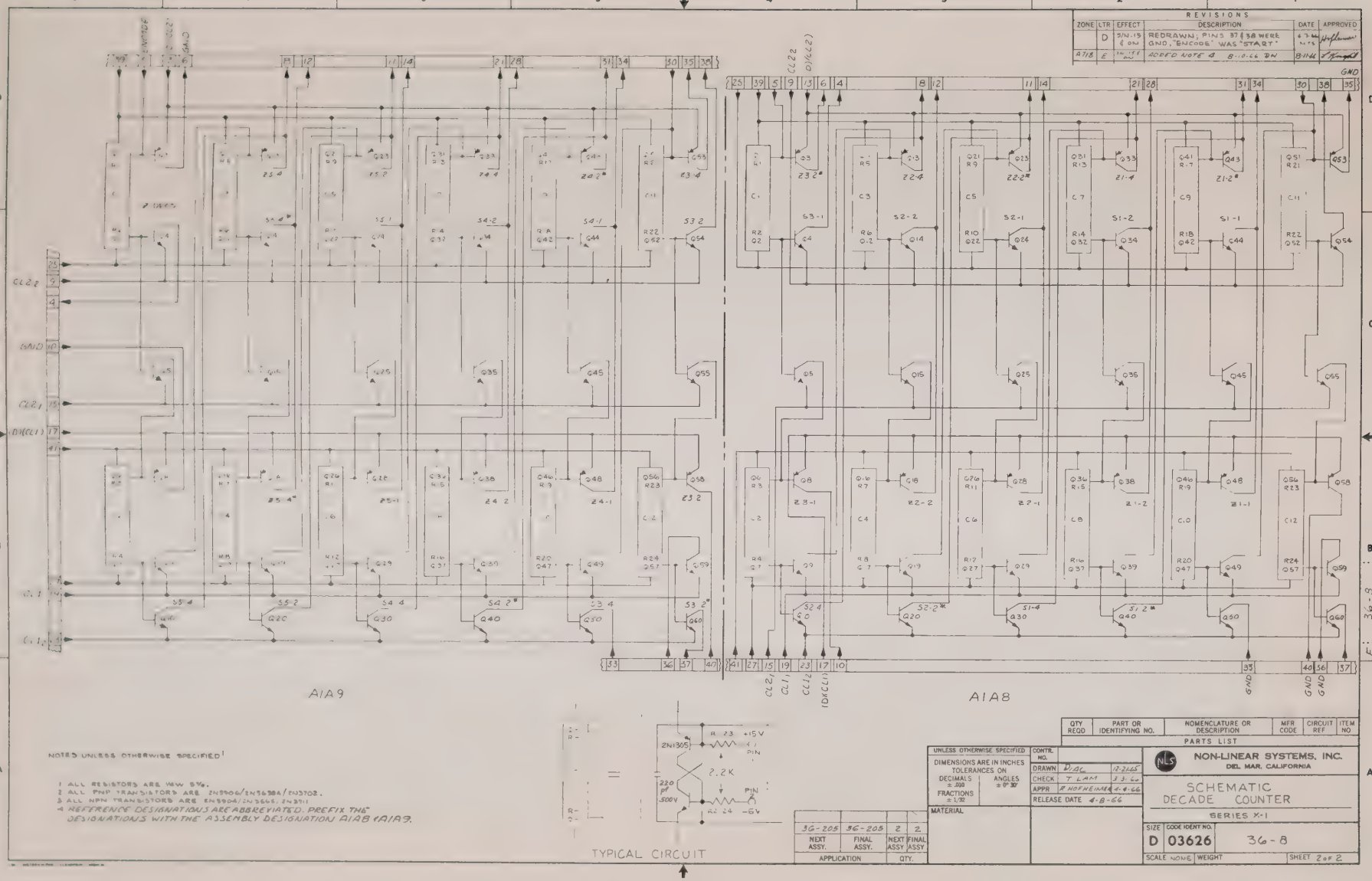
Range Decision Logic Assembly - 36-324

L = $(2 \cdot 4^*)_5$ - Low signal = 2 & 4* bit in 5th decade
L = $(1)_5$ - Low signal = 1 bit in 5th decade
H = DN = High signal = down pulse
L = 0_3 - Have low signal with number zero lighted in 3rd decade
L = 0_2 - Have low signal with number zero lighted in 2nd decade
L = 0_1 - Have low signal with number zero lighted in 1st decade
L = 0_4 - Have low signal with number zero lighted in 4th decade
H = $(2 \cdot 4)_5$ - Have high signal with 2 & 4 bit in 5th decade
H = $(1)_5$ - Have high signal with 1 bit in 5th decade
L = CHANGE POL. - Low signal = Polarity change
L = 9_4 - Have low signal with number nine lighted in 4th decade
L = 9_3 - Have low signal with number nine lighted in 3rd decade
L = 9_2 - Have low signal with number nine lighted in 2nd decade
L = 9_1 - Have low signal with number nine lighted in 1st decade
L = RANGE DN - Low signal = Down range pulse
L = RANGE UP - Low signal = Up range pulse
CL_3 - Clock Pulse

Scan Control Assembly - 36-494

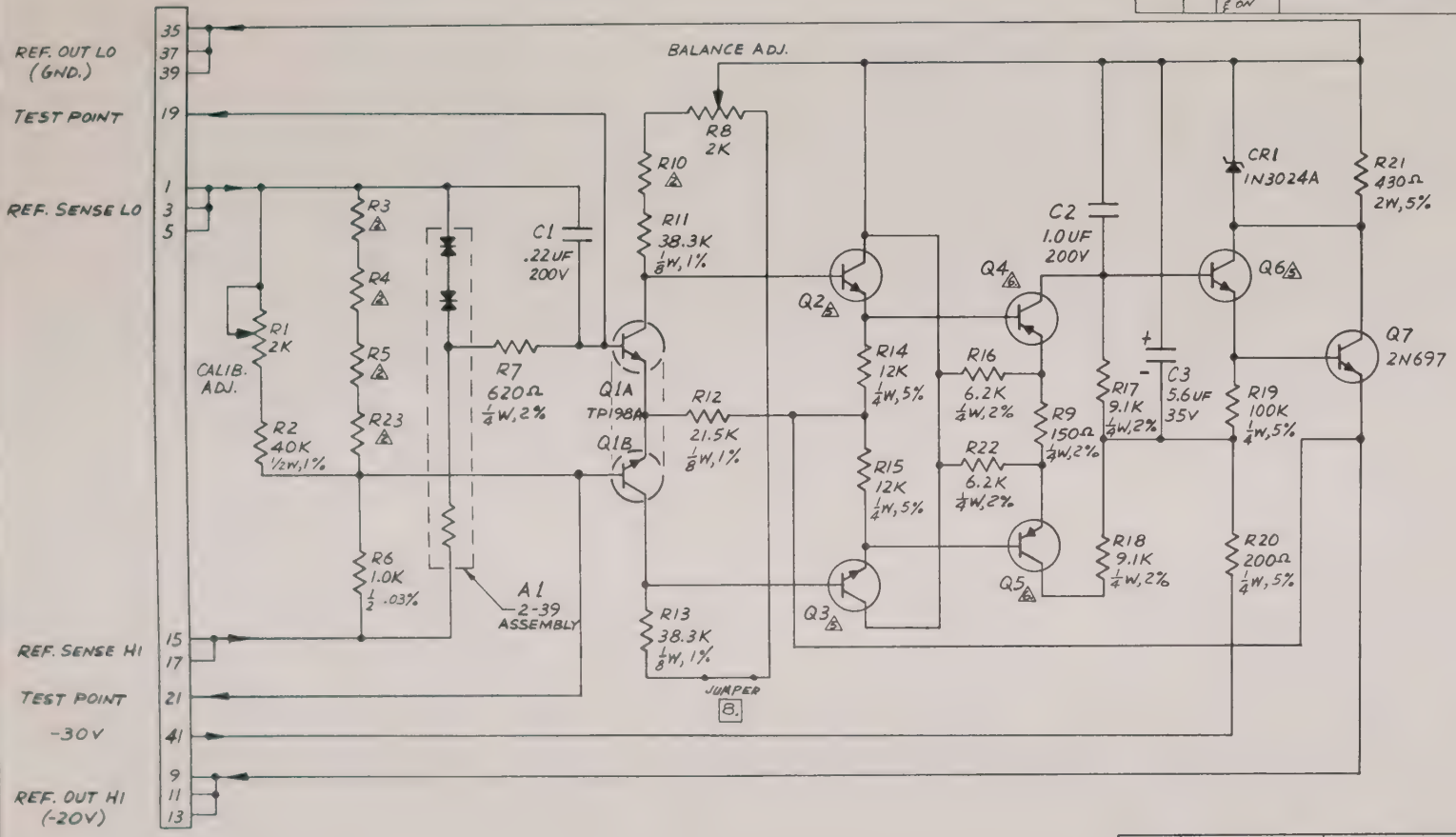
S. S. - Single scan
H = AUTO RANGE - High signal = auto range
L = RANGE UP - Low signal = up range pulse
L = 1000V RANGE - Low signal = 1000V range relay enable
L = RANGE DOWN - Low signal = down range pulse
L = 10V RANGE - Low signal = 10V range relay enable
L = CHANGE POL. - Low signal = change polarity
H = AUTO POL. - High signal = auto polarity
INT. - Internal trigger

PC_3 SET ENABLE - Program counter state 3 = set enable
PC2 - Program counter state 2


REVISIONS
ZONE | LTR | EFFECT | DESCRIPTION | DATE | APPROVED
D | 5/N-15 & ON | REDRAWN; PINS 37 & 38 WERE GND, 'ENCODE' WAS 'START' | 6-7-66 | M.Hoffman
A718 | E | 36-51 ONLY | ADDED NOTE 4 8-10-66 DN | 8-11-66 | J.Kingsley
A1A9
A1A8
CL2 2
GND
CL2 1
IDX(CL1)
CL 1
CL 2
TYPICAL CIRCUIT
2N1305
2.2K
220 pf 500V
+15 V
-6V
PIN
NOTES UNLESS OTHERWISE SPECIFIED!
1 ALL RESISTORS ARE MIN 5%.
2 ALL PNP TRANSISTORS ARE 2N3906/2N3638A/2N3703.
3 ALL NPN TRANSISTORS ARE 2N3904/2N3646, 2N3711
4 REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A1A8 (A1A9.
QTY REQD | PART OR IDENTIFYING NO. | NOMENCLATURE OR DESCRIPTION | MFR CODE | CIRCUIT REF | ITEM NO
PARTS LIST
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
CONTR. NO.
DRAWN D.AC 12-2465
CHECK T LAM 1-3-66
APPR R HOFHEIMER 4-4-66
RELEASE DATE 4-8-66
MATERIAL
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA
SCHEMATIC
DECADE COUNTER
SERIES X-1
SIZE D | CODE IDENT NO. 03626 | 36-8
SCALE NONE | WEIGHT | SHEET 2 of 2
36-205 | 36-205 | 2 | 2
NEXT ASSY. | FINAL ASSY. | NEXT ASSY | FINAL ASSY
APPLICATION | QTY.

REVISIONS					
SYM	ZONE	EFFECT	DESCRIPTION	DATE	APPROVED
F		S/N 115 & ON	ADDED NOTE 9	8/29/66	8-2-66 R.T.
G		S/N 118 & ON	INC E.O. 1 OR CHG "F"	9-12-66	9-12-66 R.T.

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
	C	S/N 1 & ON	REDRAWN WAS REV. 2.	5-3-66 WBS	Hoffheimer
F/D	D	S/N 15 & ON	CHG'D.: R7, R9, R16, R17, R18 & R22 FROM ⅛W, TO ¼W. 6-16-66 DH.	4/20/66	Hoffheimer
F/D	E	S/N 15 & ON	INCORP. E.O. 1 of CHG. D, & ADDED NOTE 7 DH.	8-10-66	L. Knight
		S/N 255 & ON	ADDED NOTE 8 & JUMPER	9/1/66	R. Warner



QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

2. R2-6 & 23 ARE PW2016 C
8. ALTERNATE LOCATION FOR R10, REF. 36-11 SHT 1 NOTE 4
7. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A3A6.
6. 2N3906, 2N3638A, MPS6518, 2N3702.
5. 2N3904, 2N3711, 2N3565
4. DOCUMENT 719 GIVES INSTRUCTION FOR ADJUSTING R1.
3. DOCUMENT 715 GIVES INSTRUCTION FOR ADJUSTING R8.
2. RESISTORS R3, 4, 5, 10 & 23 ARE SELECTED, SEE DOC. 715.
1. RESISTORS ARE ⅛ W, 2%.

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
36-208	36-205	1	1
36-203	36-204	1	1
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010 ANGLES ± 0° 30'
FRACTIONS ± 1/32

MATERIAL

CONTR. NO.		
DRAWN	H. BRINLEY	5-2-66
CHECK		5-4-66
APPR	Hoffheimer	5-9-66
RELEASE DATE	5-4-66 (2)	

NLS NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC, REFERENCE SUPPLY

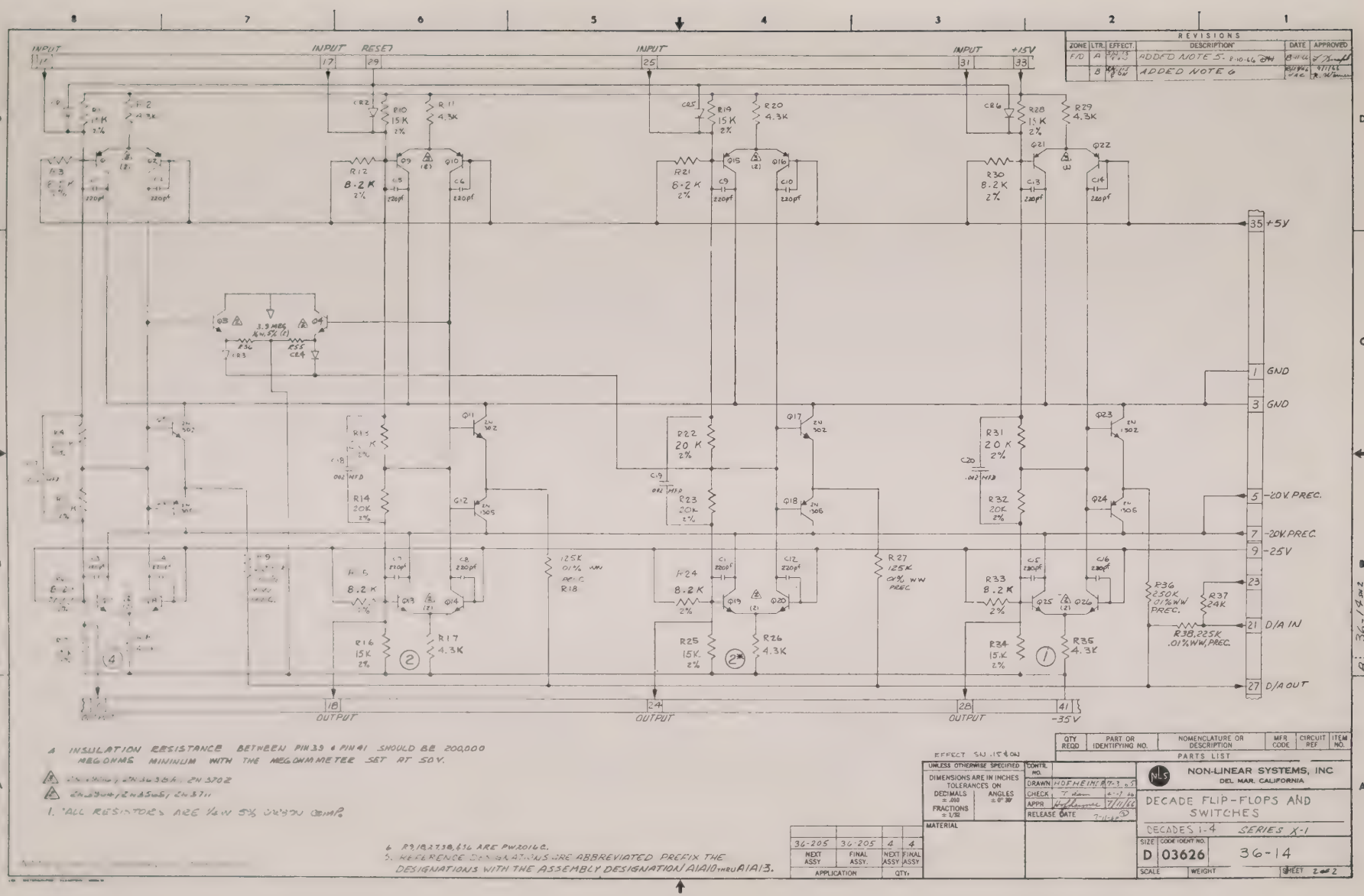
SERIES X-1

SIZE	CODE IDENT NO.	
C	03626	36-11

SCALE | WEIGHT | SHEET 2 OF 2

36-11 SH. 2

D C B A



REVISIONS				
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
F/D	A	SN 115 & ON	ADDED NOTE 5.	8-11-66	
	B	SN 115 & ON	ADDED NOTE 6	9/19/66	

A INSULATION RESISTANCE BETWEEN PIN 39 & PIN 41 SHOULD BE 200,000 MEGOHMS MINIMUM WITH THE MEGOHMMETER SET AT 50 V.

2 2N3394, 2N3645, 2N3702

3 2N3394/2N4346, 2N3711

1. ALL RESISTORS ARE 1/4W 5% UNLESS OTHERWISE NOTED.

6 P9, 18, 27, 38, & 46 ARE PW2016.

5. REFERENCE DESIGNATIONS ARE ABBREVIATED PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A1A10 THRU A1A13.

EFFECT SN 115 & ON

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF.	ITEM NO.
		PARTS LIST			

36-205	36-205	4	4	
NEXT ASSY	FINAL ASSY.	NEXT ASSY	FINAL ASSY.	APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

CONTR. NO.
DRAWN HOFHEIMER 7-1-66
CHECK T. Adam 7-1-66
APPR. [illegible] 7/11/66
RELEASE DATE 7-11-66

MATERIAL

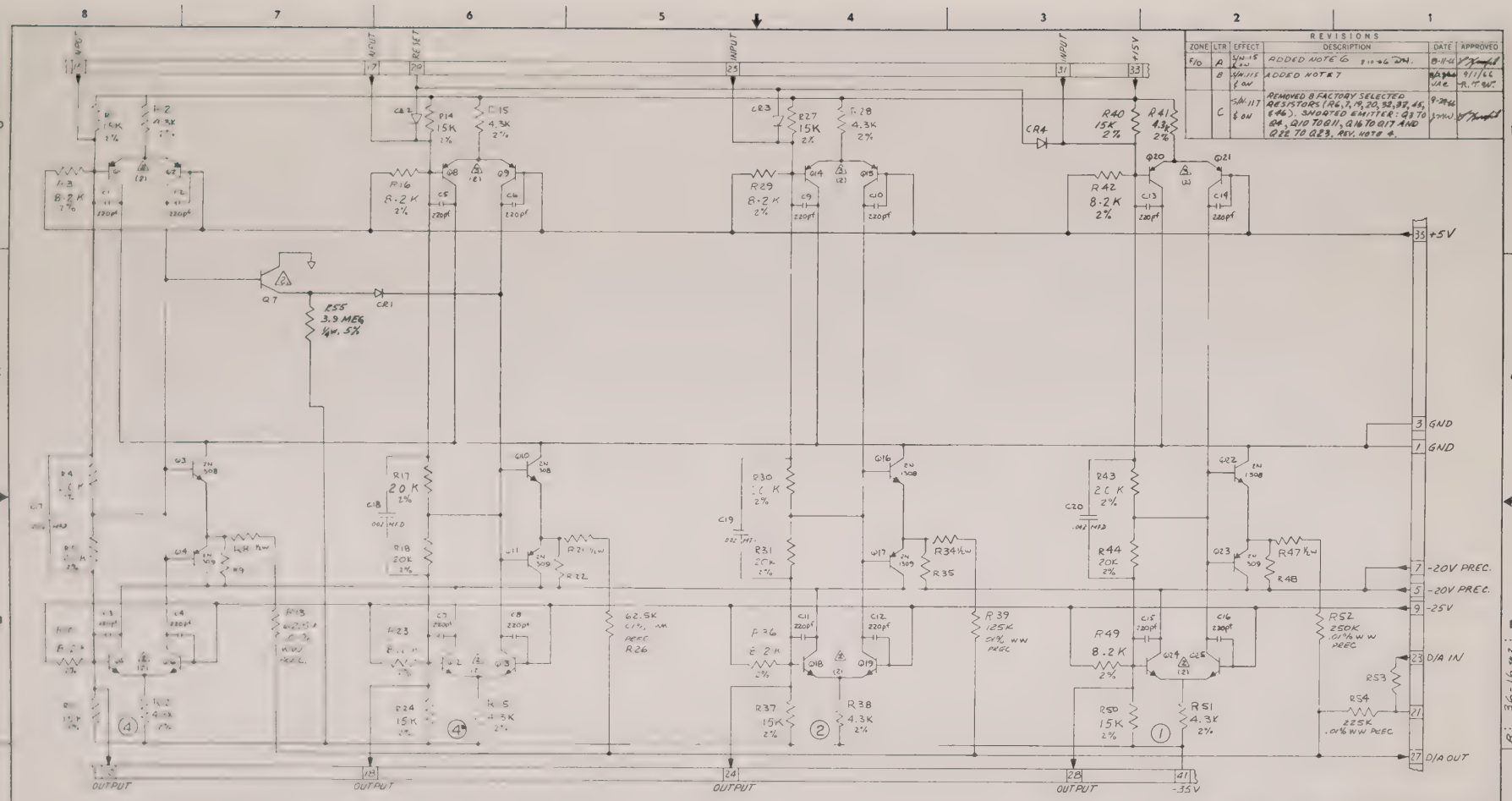
NON-LINEAR SYSTEMS, INC
DEL MAR, CALIFORNIA

DECADE FLIP-FLOPS AND SWITCHES

DECADES 1-4 SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-14
SCALE	WEIGHT	SHEET 2 of 2

B: 36-14 sh 2



5 INSULATION RESISTANCE BETWEEN PIN 33 & PIN 41 SHOULD BE 200,000 MEGOHMS MINIMUM WITH THE MEGOHMMETER SET AT 50V.

4 REFER TO NLS DOC NO 779 FOR THE SELECTION OF TRANSISTORS Q3,4,10,11,16,17,22,&23 AND TO DETERMINE THE VALUES OF RESISTORS R 8-9, 21-22, 34-35, 47-48, & 53

⚠ 2N3904/2N3565A/2N3702

⚠ 2N3904/2N3565/2N3711

1. ALL RESISTORS ARE 1/4W 5% UNLESS OTHERWISE NOTED.

7. R19,24,39,52, & 54 ARE PW200 Ω

6. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A1A14.

EFFEC. SN 115 & ON

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

36-205	36-205	1	1
NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010 | ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL

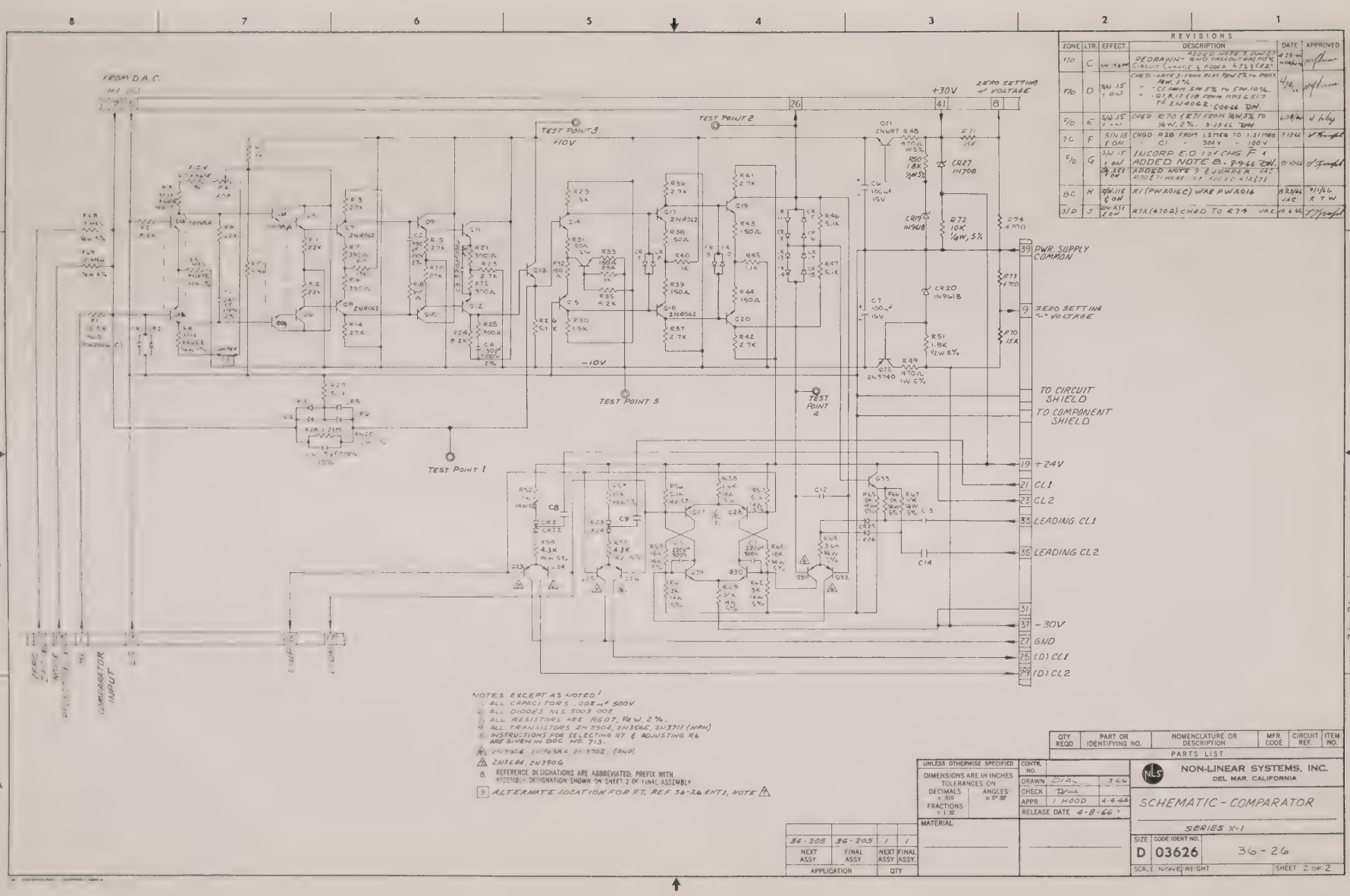
CONTR. NO.
DRAWN HOFHEIMER 7-3-65
CHECK T. Kwei 6-15-66
APPR. Hoffheimer 7-11-66
RELEASE DATE 7-11-66

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

DECADE FLIP-FLOPS AND SWITCHES DECADE 5
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-16

SCALE | WEIGHT | SHEET 2 of 2



NOTES EXCEPT AS NOTED:
1. ALL CAPACITORS .002 μF 500V
2. ALL DIODES NLS 5003 OR 2
3. ALL RESISTORS ARE RGOT, ½W, 2%.
4. ALL TRANSISTORS 2N3904, 2N3565, 2N3711 (NPN)
5. INSTRUCTIONS FOR SELECTING R7 & ADJUSTING R6 ARE GIVEN IN DOC NO. 713.
6. 2N3906 = 2N3AA 2= 3702. (PNP)
7. 2N3646, 2N3906
8. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY
9. ALTERNATE LOCATION FOR R7, REF 36-26 ANT1, NOTE 7

REVISIONS

ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
F/D	C	1/2W 2.2 OHM	REDRAWN- BIAS FOLLOWER WAS NOT A CIRCUIT CHANGE & DIODE R73 & CR27	4-25-66 VOID	
F/D	D	5W .15 1 OHM	CHG'D - A.P.E 3- FROM BLOT 1/2W 5% to R607. 1W, 2% " - C7 FROM 5W 5% to 5W, 10% " - Q7, 8, 17 (18 FROM MPS6517 TO 2N4062. C2466 DM.	4/28/66	
F/D	E	1/2W .15 1 OHM	CHG'D R70 (R71 FROM 1/2W, 5% TO 1/4W, 2%. 3-1866 DM	6/28/66	
7C	F	5W .15 1 OHM	CHG'D R28 FROM 1.27 MEG TO 1.21 MEG	7-12-66	
F/D	G	1/2W .15 1 OHM 5W .33 9 OHM	INCORP. E.O 104 CHG F & ADDED NOTE 8. 8-9-66 DM. ADDED NOTE 9 & NUMBER JAC R30(1) WERE OR ADDED R73	8-10-66	
BC	H	5W .115 & 5W 1 OHM	R1 (PWA016C) WAS PWA016	8/24/66 JAC	9/1/66 R T W
3/D	J	5W .33 1 OHM	R72 (470Ω) CHG'D TO R74 JAC	10-4-66	

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

36-205	36-205	1	1
NEXT ASSY	FINAL ASSY	NEXT ASSY	FINAL ASSY
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO.
DRAWN DAC 3-66
CHECK RMH
APPR J. HOOD 4-4-66
RELEASE DATE 4-8-66

MATERIAL

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

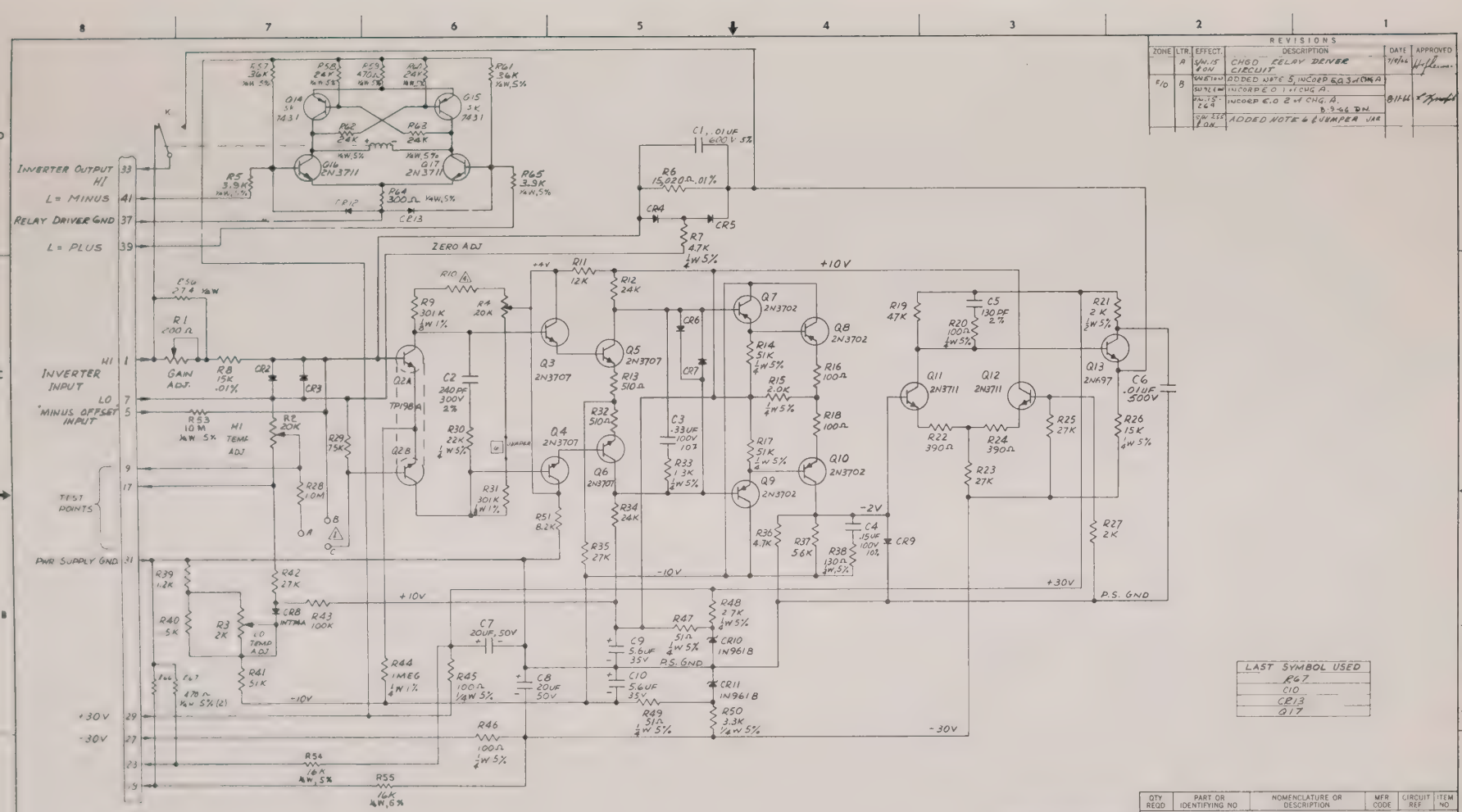
SCHEMATIC - COMPARATOR

SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-26

SCALE NONE WEIGHT SHEET 2 OF 2

H 36-26 SH 2



REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
	A	SW-15 #ON	CHGD RELAY DRIVER CIRCUIT	7/8/66	[illegible]
F/D	B	SW-2 #ON SW-3 #ON SW-15 #264 SW-15 #ON	ADDED NOTE 5, INCORP EQ 3 of CHG A INCORP E.O 1 of CHG A. INCORP E.O 2 of CHG A. 8-9-66 DM ADDED NOTE 6 & JUMPER J4E	8/1/66	[illegible]

LAST SYMBOL USED
R67
C10
CR13
Q17

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO

PARTS LIST

ALTERNATE LOCATION OF R10 REF. 36-43 SH'L NOTE ⚠
REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATIONS A3A7.

⚠ R10 IS A FACTORY SELECTED VALUE - REFER TO TEST DOC. NO. 725.

3. ALL DIODES ARE 5003-002
2. ALL RESISTORS ARE ¼ WATT, 2%
⚠ JUMPER "A" TO "B" OR "A" TO "C" - REFER TO TEMPERATURE COMPENSATION TEST DOC. NO. 705

NOTES UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED	CONTR. NO		
DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ± .010 FRACTIONS ± 1/32 ANGLES ± 0° 30'	DRAWN	M. BRINLEY	4-12-66
	CHECK	[illegible]	5-2-66
	APPR	[illegible]	7-19-66
	RELEASE DATE	7 29 66	
MATERIAL			

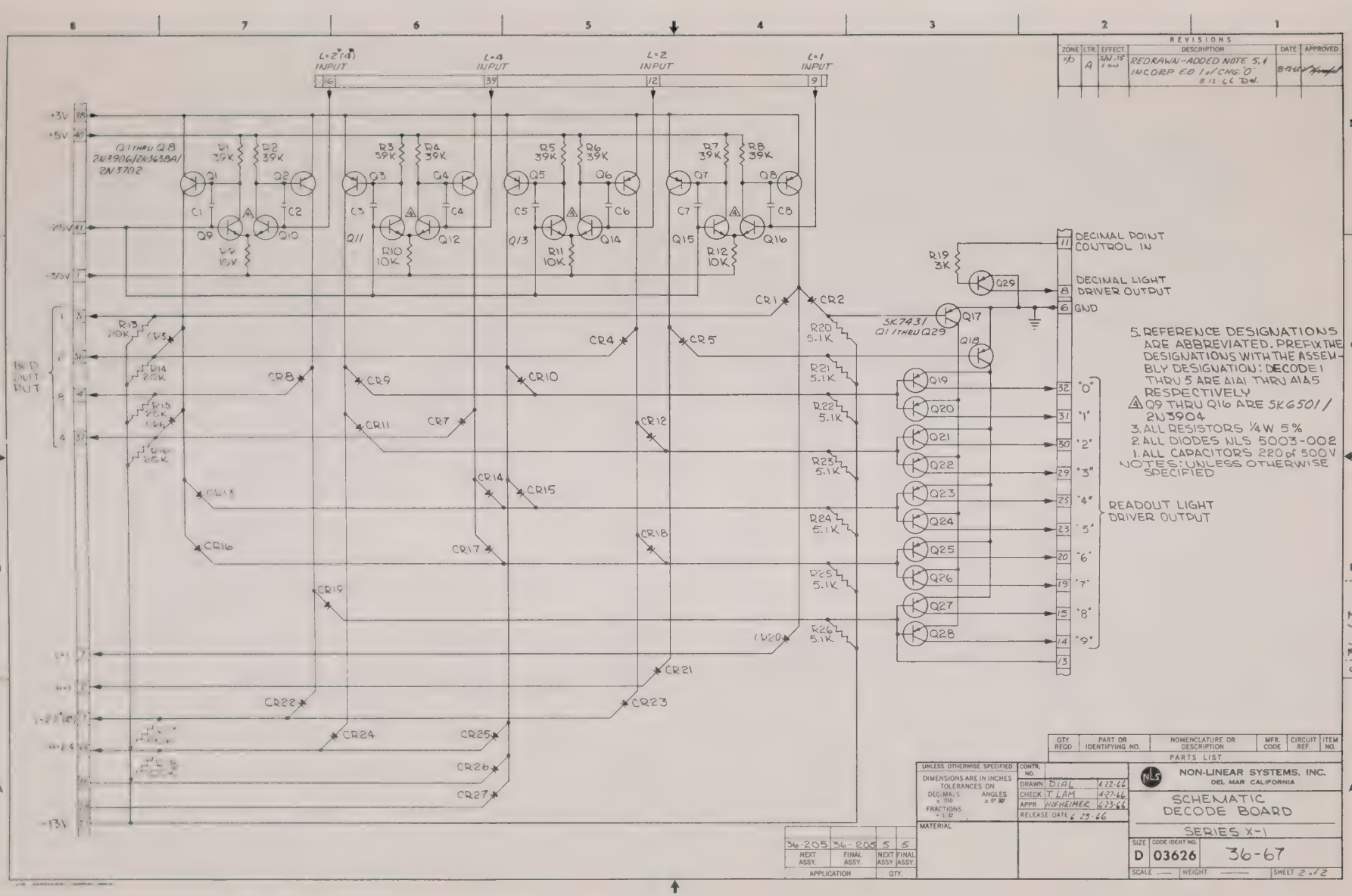
36-205	36-205	1	1
NEXT ASSY	FINAL ASSY	NEXT ASSY	FINAL ASSY
APPLICATION		QTY	

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC, INVERTER
SERIES X-1

SIZE	CODE IDENT NO	36-43
D	03626	
SCALE	WEIGHT	SHEET 2 of 2

B 36-43 Sh. 2


L-2(4) INPUT
L-4 INPUT
L-2 INPUT
L-1 INPUT
Q1 THRU Q8 2N3906/2N3638A/ 2N3702
DECIMAL POINT CONTROL IN
DECIMAL LIGHT DRIVER OUTPUT
GND
READOUT LIGHT DRIVER OUTPUT
5K7431 Q17 Q18
Q9 THRU Q16 ARE 5K6501 / 2N3904
5. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION: DECODE 1 THRU 5 ARE A1A1 THRU A1A5 RESPECTIVELY
3. ALL RESISTORS 1/4W 5%
2. ALL DIODES NLS 5003-002
1. ALL CAPACITORS 220 pf 500V
NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS					
ZONE	LTR	EFFECT.	DESCRIPTION	DATE	APPROVED
7D	A	SN 19 & ON	REDRAWN-ADDED NOTE 5, 4 INCORP ECO 1 of CHG 0 8-12-66 BW.		

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED	CONTR. NO.		
DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ± .010 ANGLES ± 0° 30' FRACTIONS ± 1/32	DRAWN	DIAL	6-22-66
	CHECK	T LAM	6-27-66
	APPR	WOHLHEIMER	6-23-66
	RELEASE DATE	6-29-66	
MATERIAL			

36-205 NEXT ASSY.	36-205 FINAL ASSY.	5 NEXT ASSY	5 FINAL ASSY.
APPLICATION		QTY.	

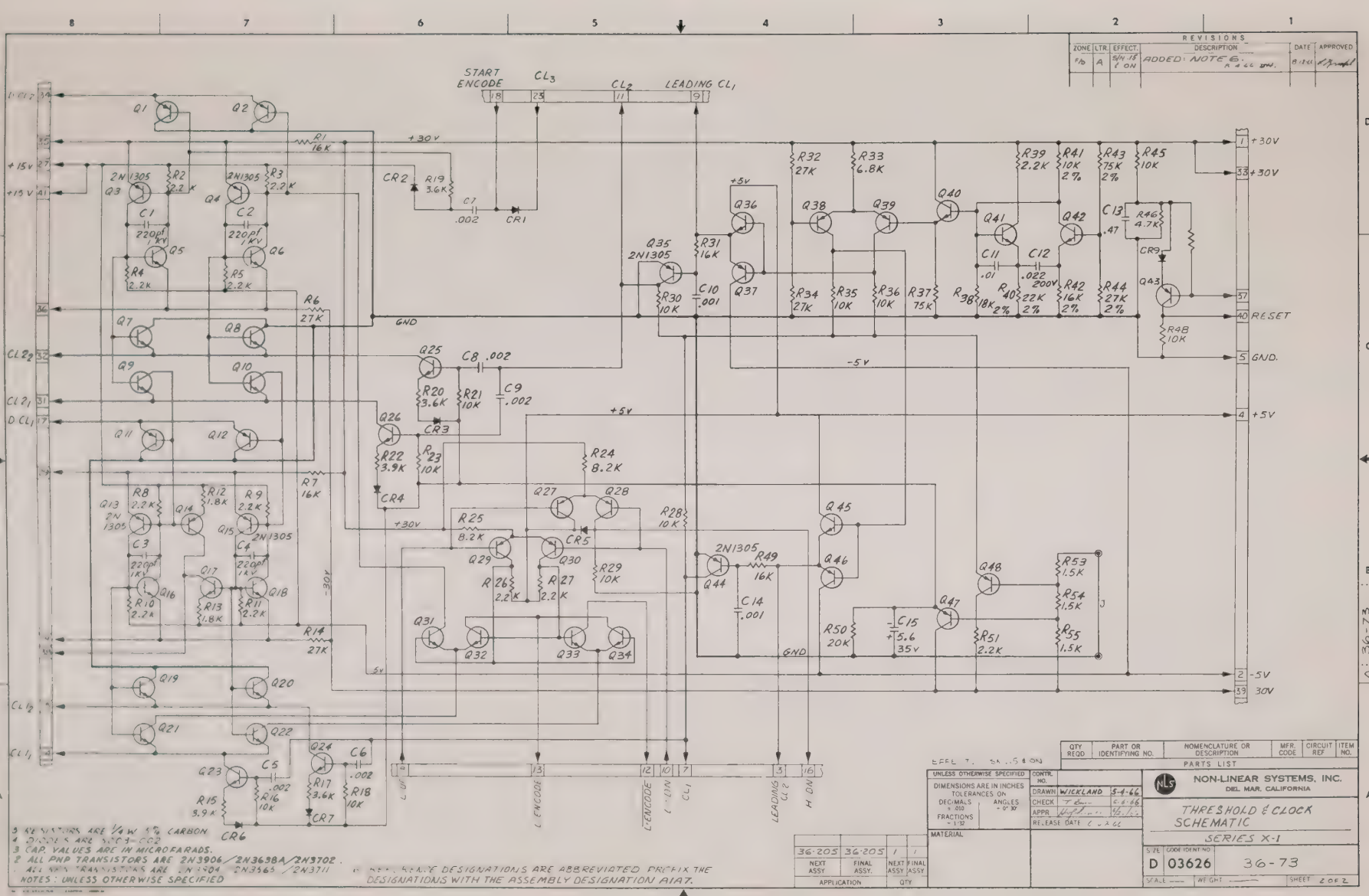
NON-LINEAR SYSTEMS, INC.
DEL MAR CALIFORNIA

SCHEMATIC
DECODE BOARD
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-67

SCALE —— WEIGHT —— SHEET 2 of 2

A 36-67 SH 2



ZONE	LTR.	EFFECT.	REVISIONS DESCRIPTION	DATE	APPROVED
F/D	A	S/N 18 & ON	ADDED: NOTE 6. A dd ON.		

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

EFFECT. S/N ..5 & ON

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'
MATERIAL

CONTR. NO.
DRAWN WICKLAND 5-1-66
CHECK 5-9-66
APPR
RELEASE DATE

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

THRESHOLD & CLOCK SCHEMATIC
SERIES X-1

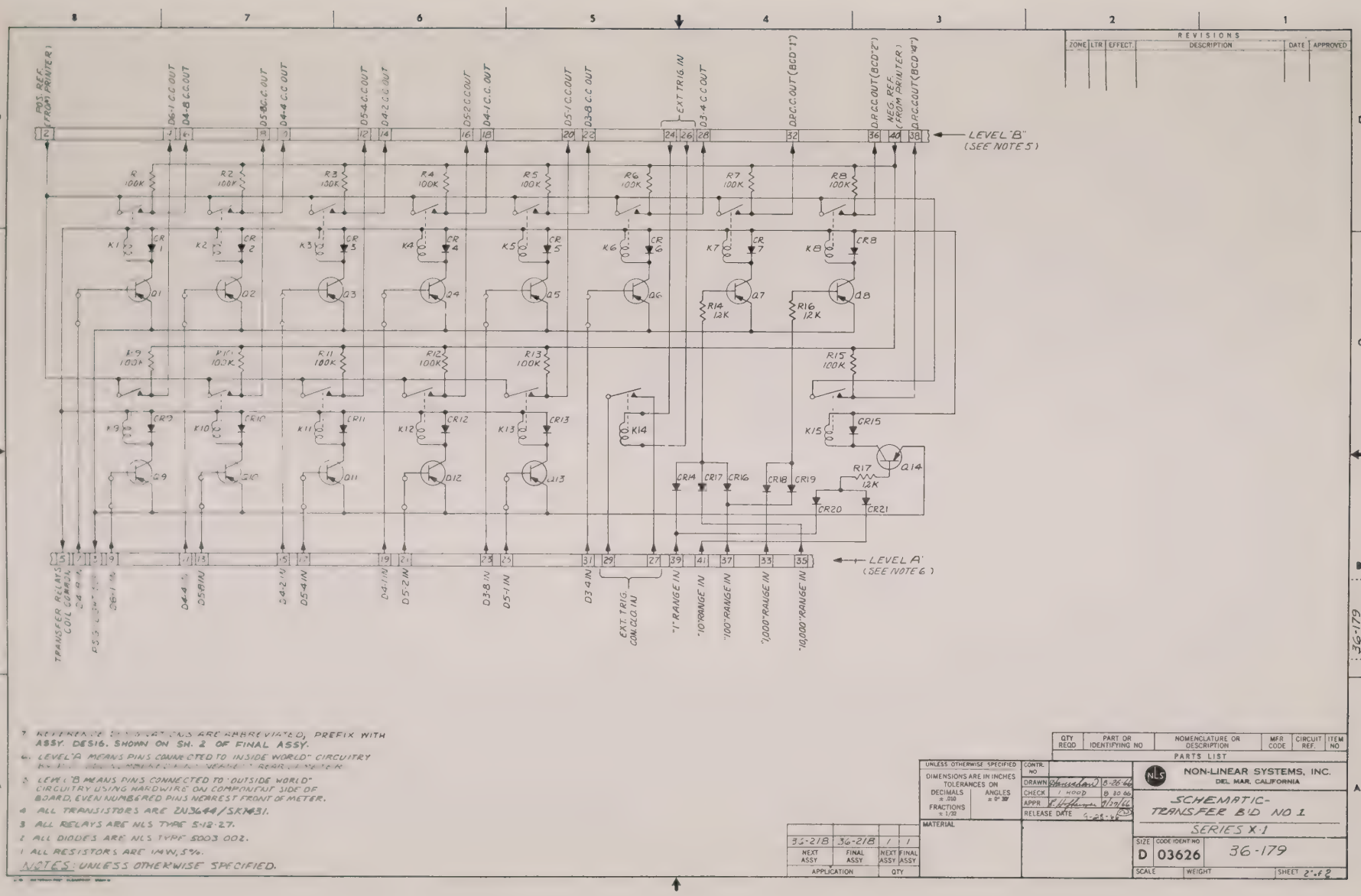
SIZE	CODE IDENT NO.	
D	03626	36-73

SCALE — WEIGHT — SHEET 2 OF 2

36-205 NEXT ASSY.	36-205 FINAL ASSY.	/ NEXT ASSY	/ FINAL ASSY
APPLICATION		QTY	

A: 36-73 SH 2

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE 1/4 W 5% CARBON
2. DIODES ARE 1N914 OR 1N2
3. CAP. VALUES ARE IN MICROFARADS.
4. ALL PNP TRANSISTORS ARE 2N3906 / 2N3638A / 2N3702.
5. ALL NPN TRANSISTORS ARE 2N3904 / 2N3563 / 2N3711
6. REFERENCE DESIGNATIONS ARE ABBREVIATED PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A1A7.



7. RESISTANCE VALUES ARE ABBREVIATED, PREFIX WITH ASSY. DES16. SHOWN ON SH. 2 OF FINAL ASSY.
6. LEVEL "A" MEANS PINS CONNECTED TO "INSIDE WORLD" CIRCUITRY [illegible]
5. LEVEL "B" MEANS PINS CONNECTED TO "OUTSIDE WORLD" CIRCUITRY USING HARDWIRE ON COMPONENT SIDE OF BOARD, EVEN NUMBERED PINS NEAREST FRONT OF METER.
4. ALL TRANSISTORS ARE 2N3644/SK1431.
3. ALL RELAYS ARE NLS TYPE S-12-27.
2. ALL DIODES ARE NLS TYPE S003 002.
1. ALL RESISTORS ARE 1/4W, 5%.

NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS					
ZONE	LTR	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF.	ITEM NO

PARTS LIST

36-218	36-218	1	1
NEXT ASSY	FINAL ASSY	NEXT ASSY	FINAL ASSY
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'
MATERIAL

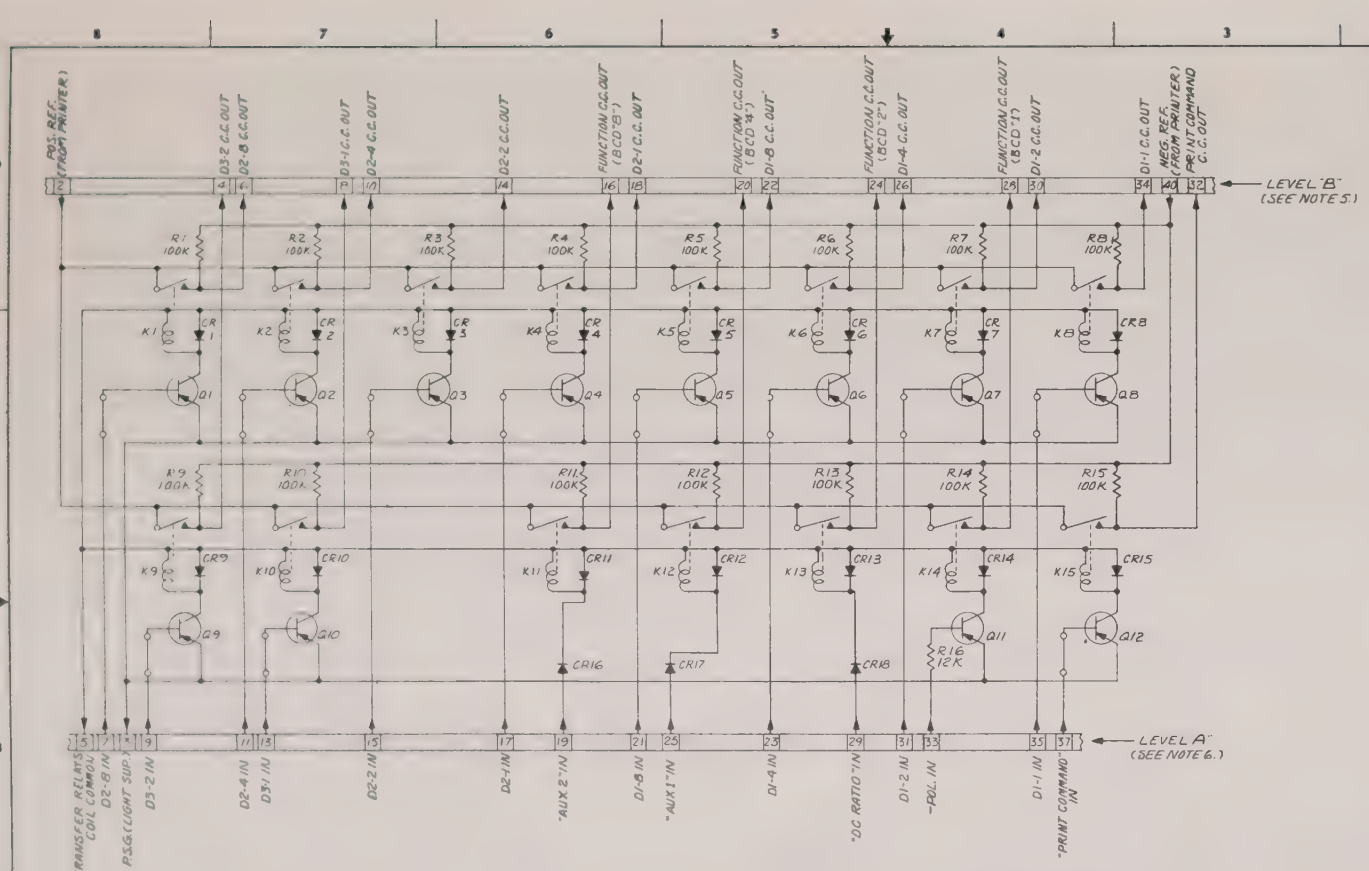
CONTR. NO
DRAWN [illegible] 8-26-66
CHECK I. HOOD 8-30-66
APPR F. Hoffman 9/20/66
RELEASE DATE 9-25-66

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC-
TRANSFER B/D NO 1
SERIES X-1

SIZE	CODE IDENT NO	36-179
D	03626	
SCALE	WEIGHT	SHEET 2 OF 2

36-179 SH. 2



7. REFERENCE DESIGNATIONS ARE ABBREVIATED; PREFIX WITH ASSY DESIG. SHOWN ON SH 2 OF FINAL ASSY.
6. LEVEL "A" MEANS PINS CONNECTED TO "INSIDE WORLD" CIRCUITRY BY [illegible] MEASURED PINS NEAREST REAR OF METER.
5. LEVEL "B" MEANS PINS CONNECTED TO "OUTSIDE WORLD" CIRCUITRY USING HARDWIRE ON COMPONENT SIDE OF BOARD, EVEN NUMBERED PINS NEAREST FRONT OF METER.
4. ALL TRANSISTORS ARE 2N3644 / SK7431.
3. ALL RELAYS ARE NLS TYPE S-12-27.
2. ALL DIODES ARE NLS TYPE S003-002.
1. ALL RESISTORS ARE 1/4W, 5%.

NOTE: UNLESS OTHERWISE SPECIFIED.

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

NEXT ASSY	FINAL ASSY.	NEXT ASSY	FINAL ASSY
36-218	36-218	1	1
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

CONTR. NO
DRAWN Yanahan P2566
CHECK I. Hood 8 30 66
APPR R. Hoffman 9/27/66
RELEASE DATE 9-29-66

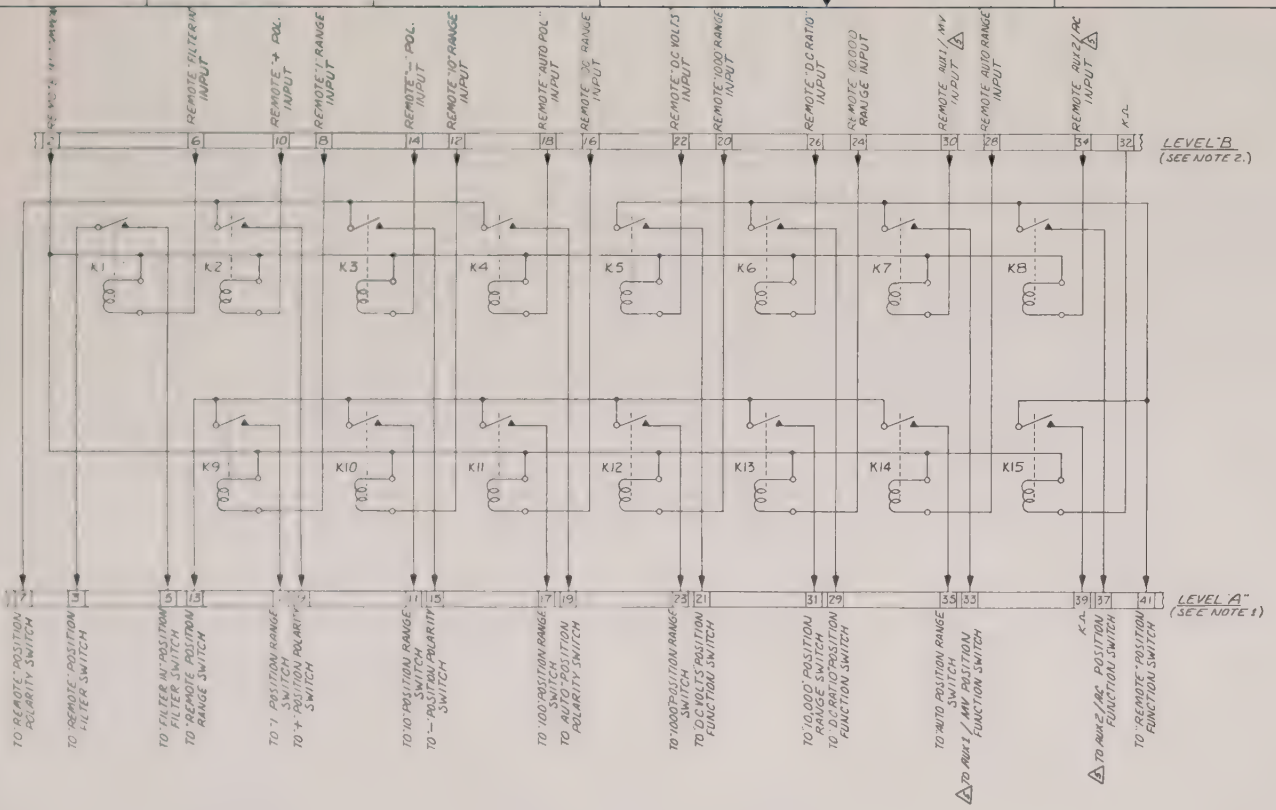
MATERIAL

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC-
TRANSFER B'D NO 2
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-182
SCALE	WEIGHT	SHEET 2 of 2

36-182 SH 2



ZONE	LTR	EFFECT	REVISIONS DESCRIPTION	DATE	APPROVED
	A		ADDED, "2.0" AT PIN 32 & 33", "1 MV" AT PIN 30 & 33". ADDED NOTE 5. TD		

⚠ 'AUX 1' & 'AUX 2' APPLY TO 36-218 ONLY.

4 REF DESIG ARE ABBREV.; PREFIX WITH ASSY DESIG SHOWN ON SH. 2 OF FINAL ASSY.

3 ALL RELAYS ARE NLS TYPE S-12-27.

2 LEVEL 'B' MEANS PINS CONNECTED TO "OUTSIDE WORLD" CIRCUITRY USING HARDWIRE ON COMPONENT SIDE OF BOARD, EVEN NUMBERED PINS NEAREST FRONT OF METER.

1 LEVEL 'A' MEANS PINS CONNECTED TO "INSIDE WORLD" CIRCUITRY BY P.C. ODD NUMBERED PINS NEAREST REAR OF METER.

NOTES: UNLESS OTHERWISE SPECIFIED.

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO

PARTS LIST

36-218	36-218	1	1
NEXT ASSY	FINAL ASSY	NEXT ASSY	FINAL ASSY
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
CONTR. NO
DRAWN Hernandez 8-29-66
CHECK [illegible] 8-29-66
APPR. [illegible] 8-29-66
RELEASE DATE 8-25-66
MATERIAL

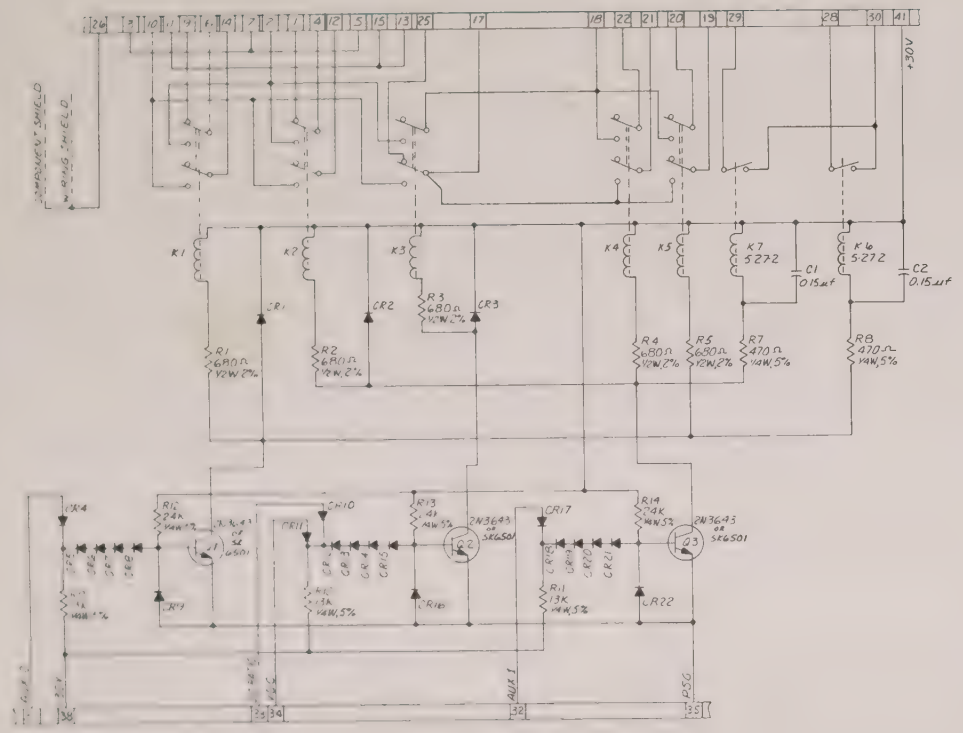
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC - (REMOTE INPUT) TRANSFER BOARD #3
SERIES X-1

SIZE	CODE IDENT NO	36-185
D	03626	

SCALE — WEIGHT — SHEET 2 of 2

36-185 SH 2 of 2



3. CR* 1N914 ARE ASSEMBLY ; PREFIX WITH ASSY. DESIG. SHOWN ON SH 2 OF FINAL ASSY.
2. K1 THRU K5 ARE NLS TYPE 5005-007 RELAYS
1. ALL DIODES ARE NLS TYPE 5003-002

NOTES: UNLESS OTHERWISE SPECIFIED.

ZONE	LTR.	EFFECT.	REVISIONS DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

36-218	36-218	1	1	
NEXT ASSY.	FINAL ASSY.	NEXT ASSY	FINAL ASSY.	QTY.

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

CONTR. NO.
DRAWN [illegible] 7-1-66
CHECK D FOLEY 9-8 66
APPR R Hyhum 9/22/66
RELEASE DATE 7-14-66

MATERIAL

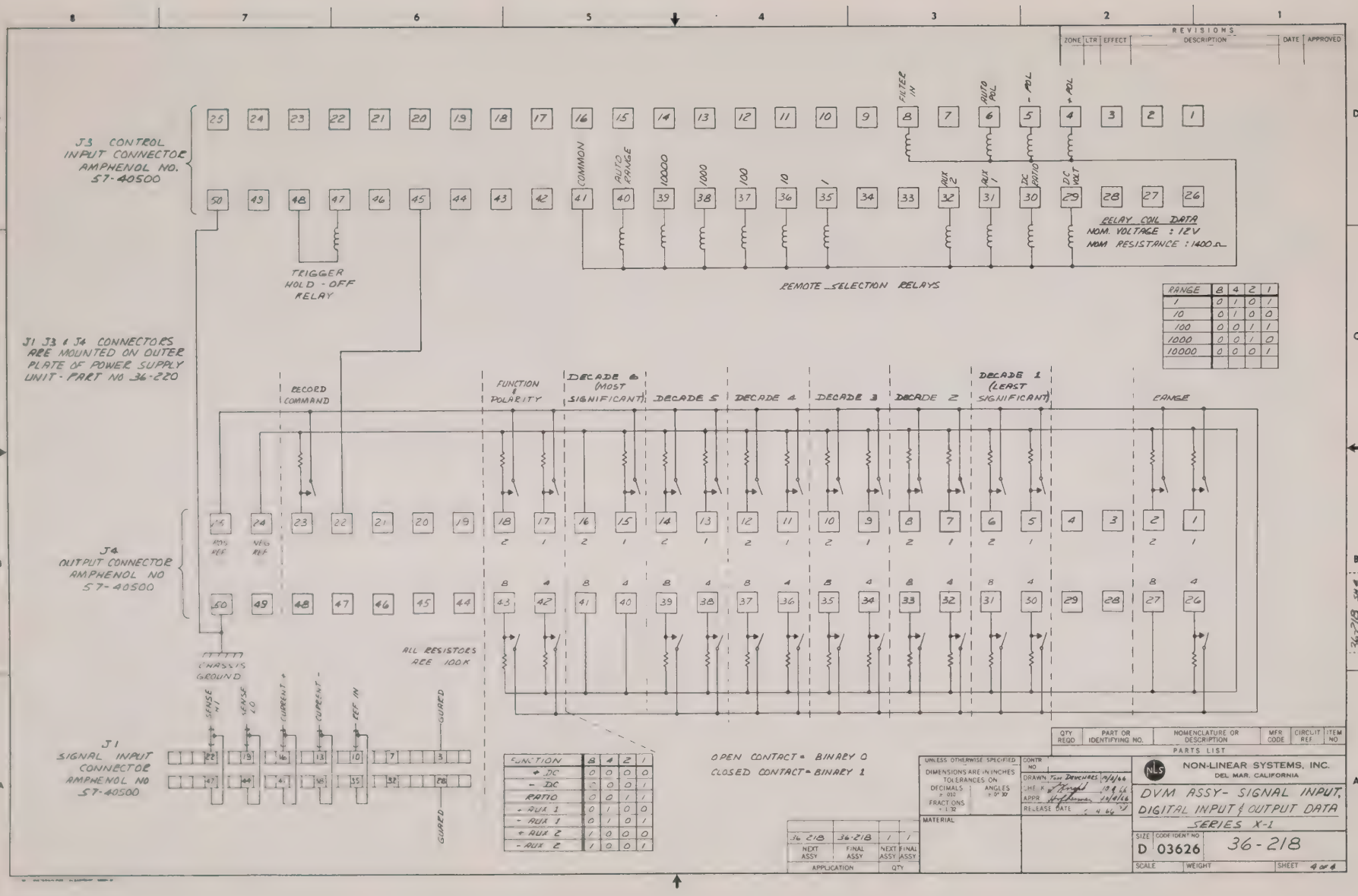
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC —
FUNCTION SWITCHING LOGIC
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-191

SCALE | WEIGHT | SHEET 2 of 2

36-191


REVISIONS
ZONE | LTR | EFFECT | DESCRIPTION | DATE | APPROVED
J3 CONTROL INPUT CONNECTOR AMPHENOL NO. S7-40500
J1 J3 & J4 CONNECTORS ARE MOUNTED ON OUTER PLATE OF POWER SUPPLY UNIT - PART NO 36-220
J4 OUTPUT CONNECTOR AMPHENOL NO S7-40500
J1 SIGNAL INPUT CONNECTOR AMPHENOL NO S7-40500
FILTER IN
AUTO POL
- POL
+ POL
COMMON
AUTO RANGE
10000
1000
100
10
1
AUX 2
AUX 1
DC RATIO
DC VOLT
TRIGGER HOLD - OFF RELAY
REMOTE SELECTION RELAYS
RELAY COIL DATA
NOM. VOLTAGE : 12V
NOM RESISTANCE : 1400Ω
RANGE | 8 | 4 | 2 | 1
1 | 0 | 1 | 0 | 1
10 | 0 | 1 | 0 | 0
100 | 0 | 0 | 1 | 1
1000 | 0 | 0 | 1 | 0
10000 | 0 | 0 | 0 | 1
RECORD COMMAND
FUNCTION & POLARITY
DECADE 6 (MOST SIGNIFICANT)
DECADE 5
DECADE 4
DECADE 3
DECADE 2
DECADE 1 (LEAST SIGNIFICANT)
RANGE
+5V REF
NEG REF
CHASSIS GROUND
ALL RESISTORS ARE 100K
SENSE +I
SENSE -I
CURRENT +
CURRENT -
REF IN
GUARDED
GUARDED
FUNCTION | 8 | 4 | 2 | 1
+ DC | 0 | 0 | 0 | 0
- DC | 0 | 0 | 0 | 1
RATIO | 0 | 0 | 1 | 1
+ AUX 1 | 0 | 1 | 0 | 0
- AUX 1 | 0 | 1 | 0 | 1
+ AUX 2 | 1 | 0 | 0 | 0
- AUX 2 | 1 | 0 | 0 | 1
OPEN CONTACT = BINARY 0
CLOSED CONTACT = BINARY 1

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF.	ITEM NO.
		PARTS LIST			

36-218	36-218	1	1
NEXT ASSY	FINAL ASSY	NEXT ASSY	FINAL ASSY
APPLICATION		QTY	

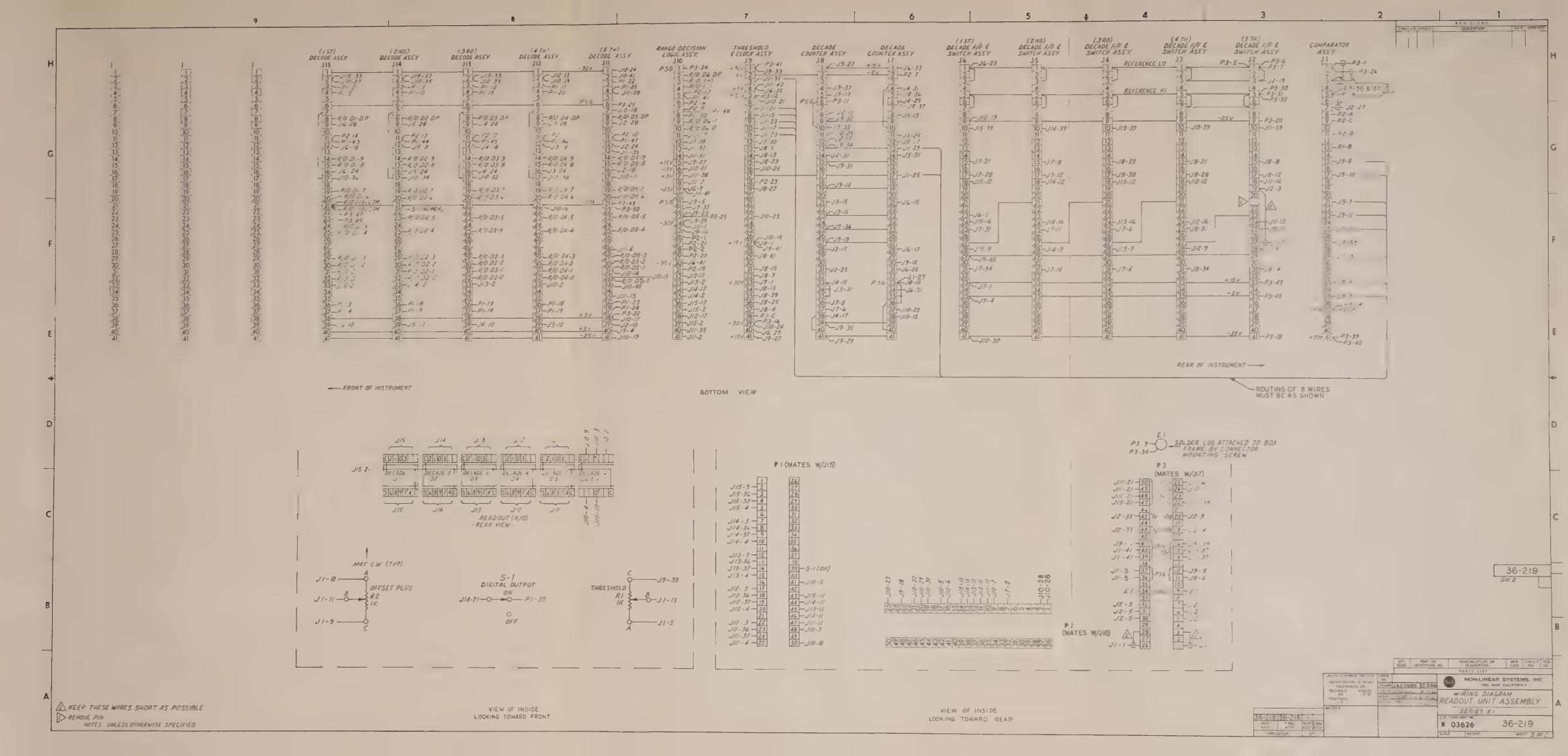
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'
CONTR NO
DRAWN Tom Deschres 10/4/66
CHK K Wright 10/4/66
APPR H Hammer 10/4/66
RELEASE DATE 4/4/67
MATERIAL

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

DVM ASSY- SIGNAL INPUT, DIGITAL INPUT & OUTPUT DATA
SERIES X-1

SIZE	CODE IDENT NO	36-218
D	03626	
SCALE	WEIGHT	SHEET 4 of 4

36-218 SH 4


(1ST) DECODE ASS'Y
(2ND) DECODE ASS'Y
(3RD) DECODE ASS'Y
(4TH) DECODE ASS'Y
(5TH) DECODE ASS'Y
RANGE DECISION LOGIC ASS'Y.
THRESHOLD & CLOCK ASS'Y.
DECADE COUNTER ASS'Y
DECADE COUNTER ASS'Y
(1ST) DECADE F/F & SWITCH ASS'Y
(2ND) DECADE F/F & SWITCH ASS'Y
(3RD) DECADE F/F & SWITCH ASS'Y
(4TH) DECADE F/F & SWITCH ASS'Y
(5TH) DECADE F/F & SWITCH ASS'Y
COMPARATOR ASS'Y
REFERENCE LO
REFERENCE HI
FRONT OF INSTRUMENT
BOTTOM VIEW
REAR OF INSTRUMENT
ROUTING OF 8 WIRES MUST BE AS SHOWN
READOUT (R/O) - REAR VIEW -
MAX C.W. (TYP.)
OFFSET PLUS
S-1 DIGITAL OUTPUT ON
OFF
THRESHOLD R1 1K
P1 (MATES W/J15)
P3 (MATES W/J17)
P2 (MATES W/J16)
E1 SOLDER LUG ATTACHED TO BOX FRAME BY CONNECTOR MOUNTING SCREW
VIEW OF INSIDE LOOKING TOWARD FRONT
VIEW OF INSIDE LOOKING TOWARD REAR

⚠ KEEP THESE WIRES SHORT AS POSSIBLE
▷ REMOVE PIN
NOTES UNLESS OTHERWISE SPECIFIED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO.

PARTS LIST

REV	ITR	DESCRIPTION	DATE	APPROVED

DRAWN J.A.COMBS 10-3-66
CHECKED
ENGR APPROVED
MFG APPROVED
QUALITY APPROVED

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

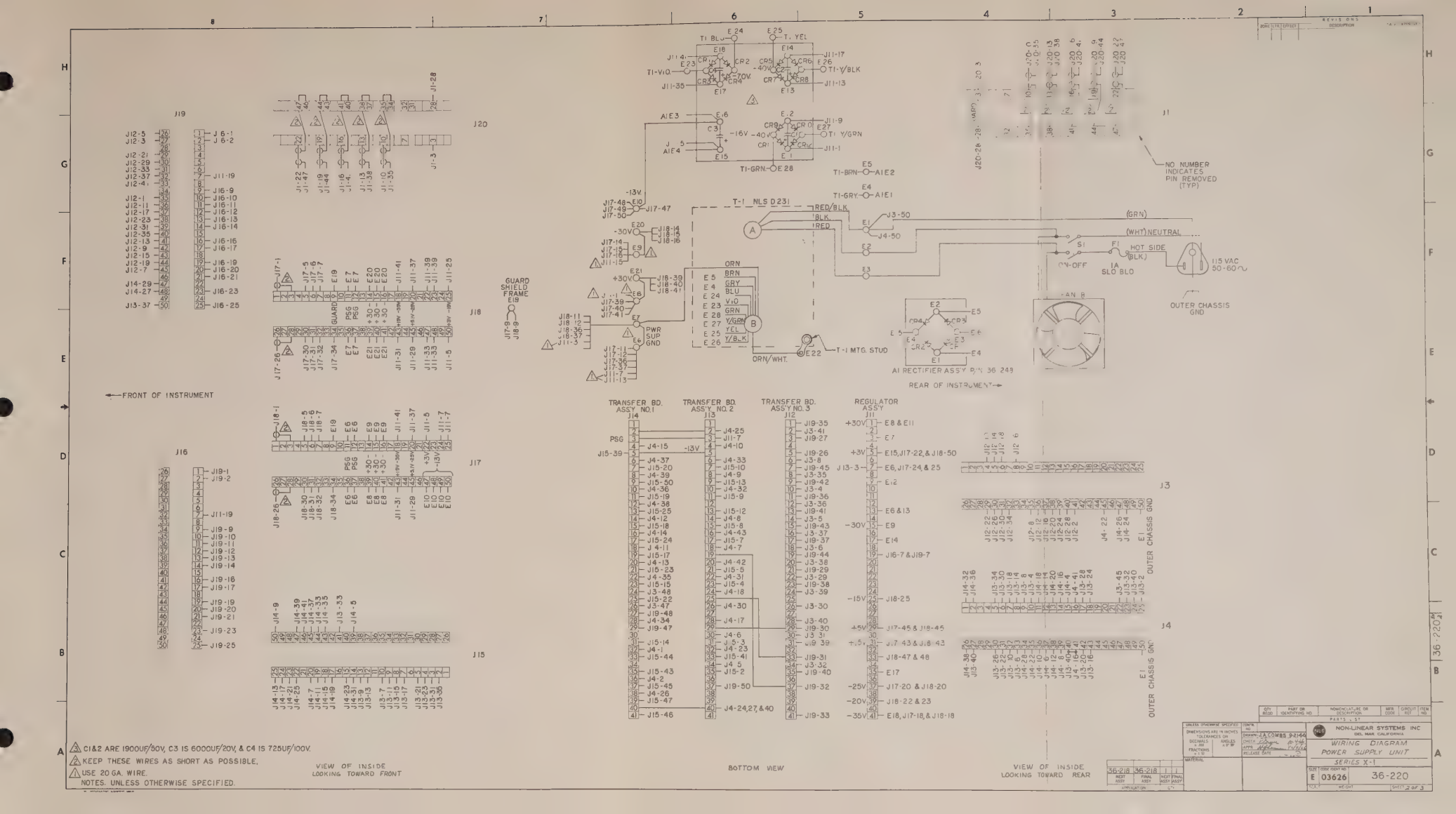
WIRING DIAGRAM
READOUT UNIT ASSEMBLY
SERIES X-1

SIZE	CODE IDENT NO	DWG NO	REV
D	03626	36-219	

SCALE — WEIGHT — SHEET 2 OF 2

36-218 36-218

36-219
SH 2

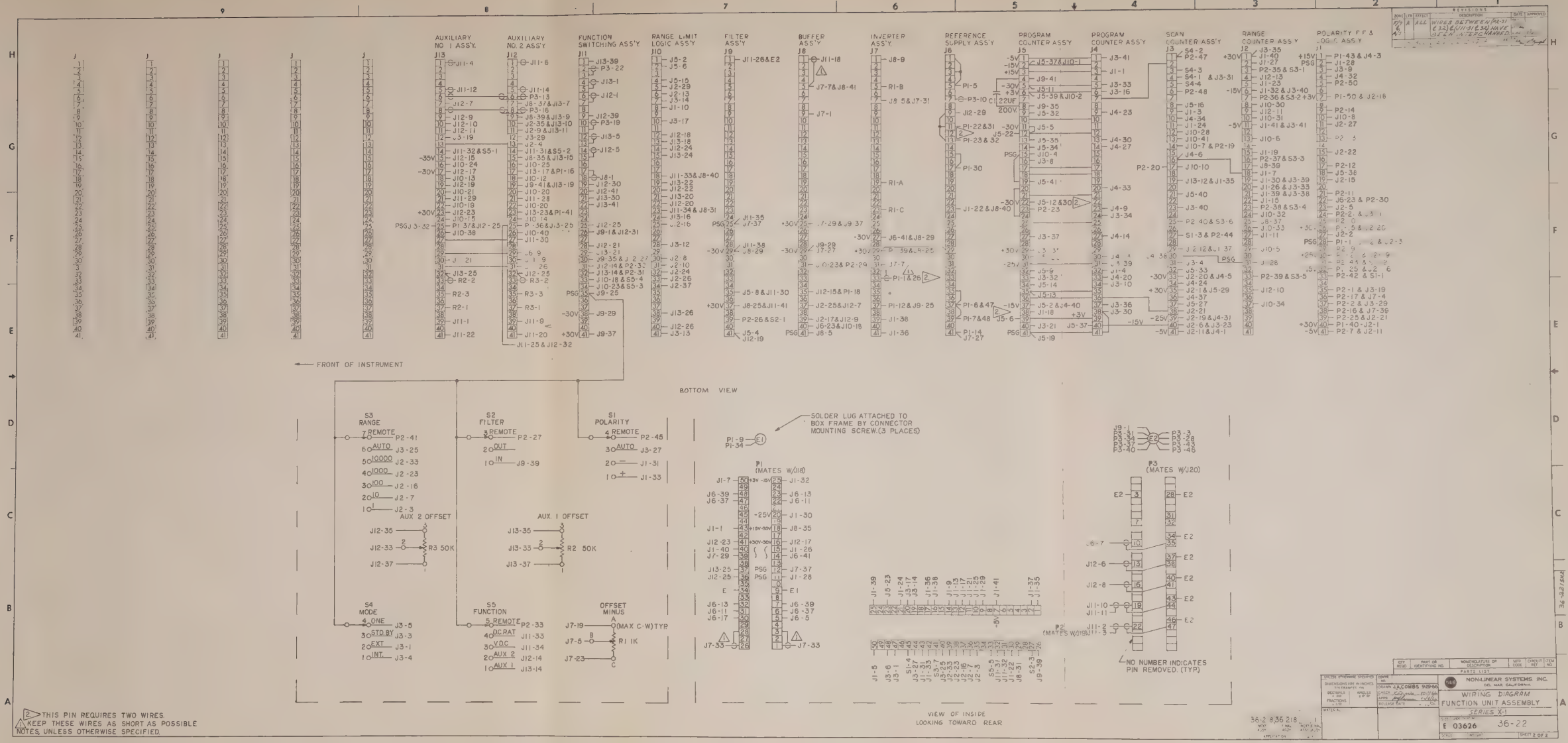


C1&2 ARE 1900UF/30V, C3 IS 6000UF/20V, & C4 IS 725UF/100V.

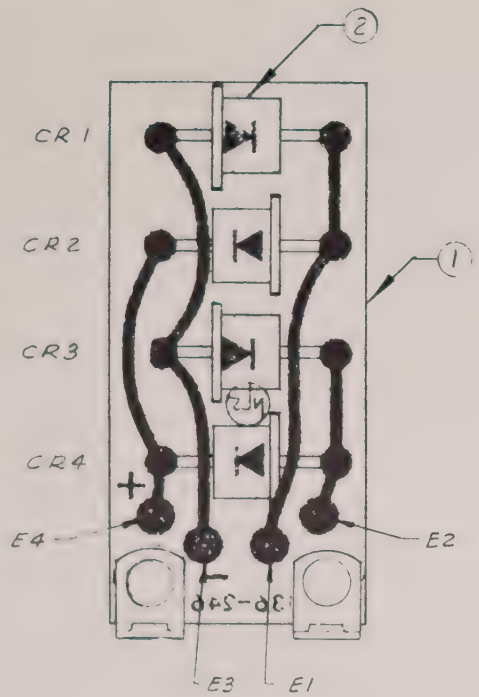
KEEP THESE WIRES AS SHORT AS POSSIBLE.

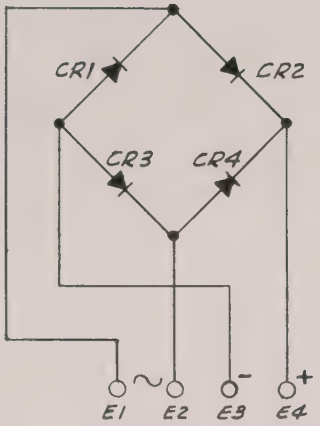
USE 20 GA. WIRE.

NOTES. UNLESS OTHERWISE SPECIFIED.


AUXILIARY NO. 1 ASSY.
AUXILIARY NO. 2 ASSY.
FUNCTION SWITCHING ASS'Y
RANGE LIMIT LOGIC ASS'Y
FILTER ASS'Y
BUFFER ASS'Y
INVERTER ASS'Y
REFERENCE SUPPLY ASS'Y
PROGRAM COUNTER ASS'Y
PROGRAM COUNTER ASS'Y
SCAN COUNTER ASS'Y
RANGE COUNTER ASS'Y
POLARITY F/F & LOGIC ASS'Y
FRONT OF INSTRUMENT
BOTTOM VIEW
S3 RANGE
S2 FILTER
S1 POLARITY
S4 MODE
S5 FUNCTION
OFFSET MINUS
AUX 2 OFFSET
AUX 1 OFFSET
SOLDER LUG ATTACHED TO BOX FRAME BY CONNECTOR MOUNTING SCREW.(3 PLACES)
P1 (MATES W/J18)
P2 (MATES W/J19)
P3 (MATES W/J20)
NO NUMBER INDICATES PIN REMOVED. (TYP.)
VIEW OF INSIDE LOOKING TOWARD REAR
THIS PIN REQUIRES TWO WIRES.
KEEP THESE WIRES AS SHORT AS POSSIBLE
NOTES, UNLESS OTHERWISE SPECIFIED.
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA
WIRING DIAGRAM
FUNCTION UNIT ASSEMBLY
SERIES X-1
E 03626
36-22
SHEET 2 OF 2

REVISIONS					
ZONE	LTR	EFFECT	DESCRIPTION	DATE	APPROVED





QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.
4	IN4720	DIODE	04713		2
1	36-247	RECT. BD. SUB-ASSY			1

PARTS LIST

REFERENCE DESIGNATIONS ARE ABBREVIATED; PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY

NOTE –
1. CIRCUITRY & TERMINALS ARE ON FAR SIDE OF ITEM 1 – REF.

36-220 NEXT ASSY	36-218 FINAL ASSY	1 NEXT ASSY	1 FINAL ASSY
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

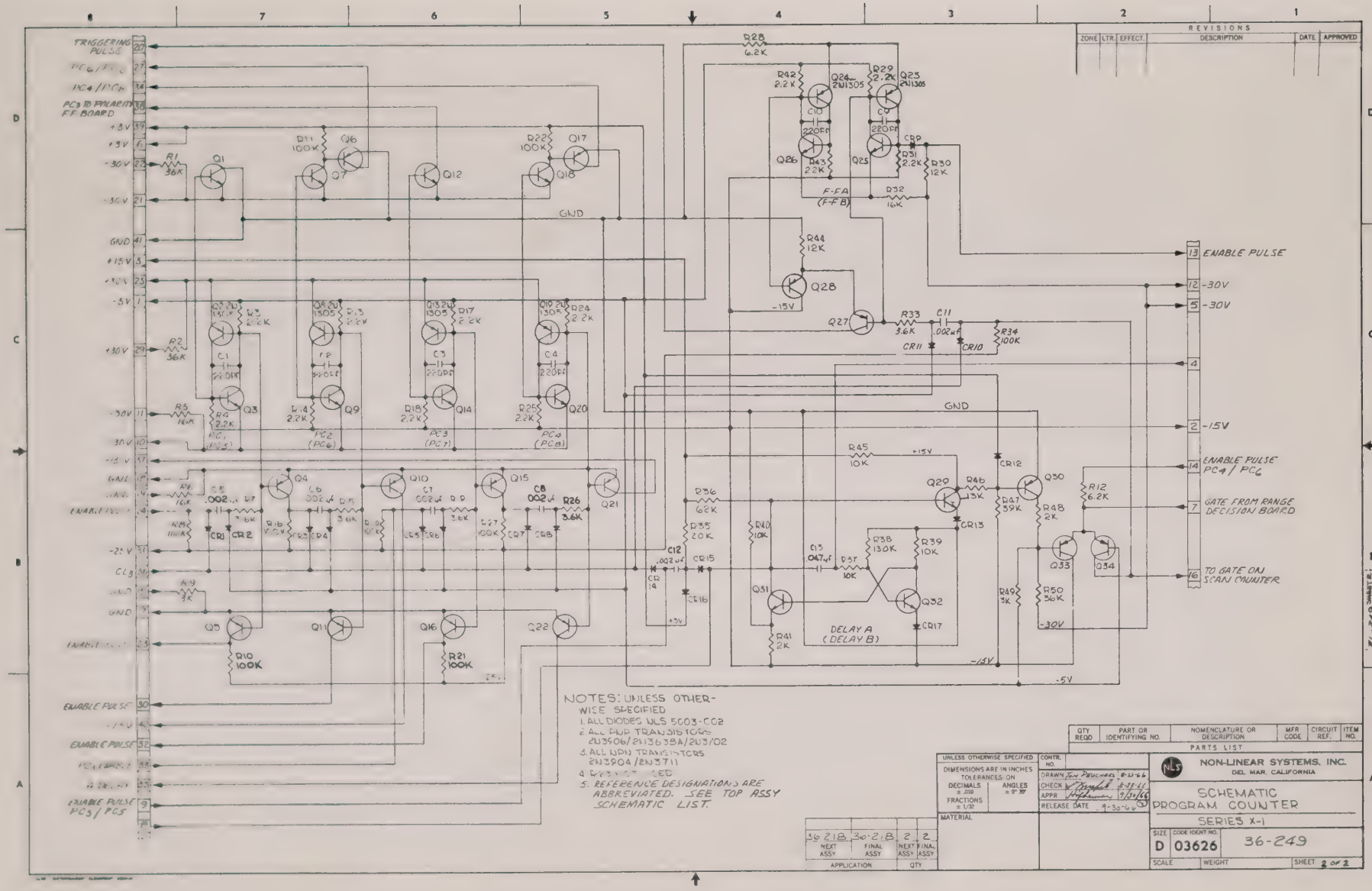
MATERIAL

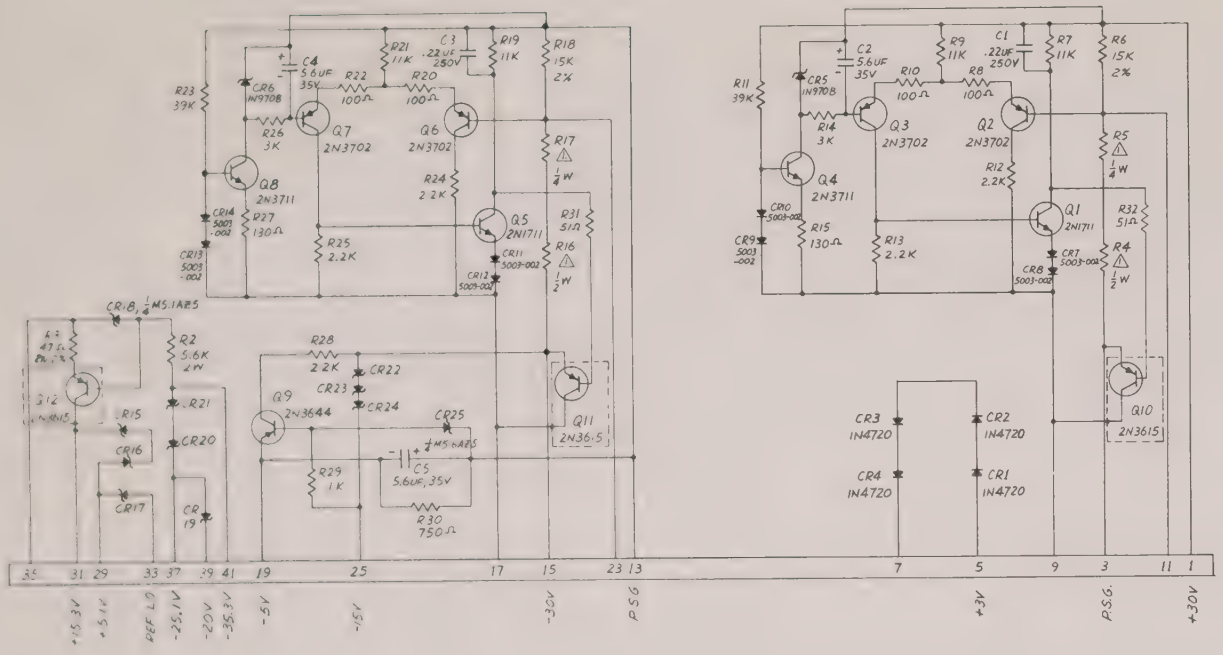
CONTR NO		
DRAWN	T. SOULÉ	8-1-66
CHECK	D FOLEY	9-22-66
APPR	[illegible]	9/27/66
RELEASE DATE	9-28-66	

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

RECTIFIER ASSEMBLY & SCHEMATIC

SIZE	CODE IDENT NO.	36-248
B	03626	
SCALE	WEIGHT	SHEET


TRIGGERING PULSE
PC6/PC6
PC4/PC4
PC3 ID POLARITY F.F. BOARD
+8V
+5V
-30V
-30V
GND
GND
+15V
+10V
-5V
+30V
-30V
-30V
-15V
GND
ENABLE...
-25V
GND
GND
ENABLE...
-15V
ENABLE PULSE
-15V
ENABLE PULSE
PC3/PC5
R1 36K
R2 36K
R5 16K
R28 6.2K
R42 2.2K
R29 2.2K
Q24 2N1305
Q23 2N1305
C10 220PF
C9 220PF
Q26
Q25
R43 2.2K
R31 2.2K
R30 12K
F-FA (F-FB)
R32 16K
R44 12K
Q28
-15V
Q27
R33 3.6K
C11 .002μf
CR11
CR10
R34 100K
ENABLE PULSE
-30V
-30V
GND
-15V
ENABLE PULSE PC4/PC6
GATE FROM RANGE DECISION BOARD
TO GATE ON SCAN COUNTER
R45 10K
+15V
CR12
Q29
R46 13K
Q30
R47 39K
R48 2K
R12 6.2K
CR13
Q33
Q34
R36 62K
R35 20K
R40 10K
C12 .002μf
CR14
CR15
C13 .047μf
R37 10K
R38 130K
R39 10K
CR16
+5V
Q31
Q32
CR17
R41 2K
DELAY A (DELAY B)
R49 3K
R50 36K
-30V
-15V
-5V
Q1
Q7
Q12
Q18
R11 100K
R22 100K
Q17
Q3
Q9
Q14
Q20
R4 2.2K
R13 2.2K
R17 2.2K
R24 2.2K
R18 2.2K
R25 2.2K
C1 .22 DIFF
C2 .22 DIFF
C3 .22 DIFF
C4 .22 DIFF
PC2 (PC6)
PC3 (PC7)
PC4 (PC8)
Q4
Q10
Q15
Q21
R7 3.6K
R15 3.6K
R27 100K
R26 3.6K
C5 .002μf
C6 .002μf
C7 .002μf
C8 .002μf
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
R8 100K
R16 100K
R19 3K
Q5
Q11
Q16
Q22
R10 100K
R21 100K
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL DIODES IN5003-CC2
2. ALL PNP TRANSISTORS 2N3906/2N3638A/2N3702
3. ALL NPN TRANSISTORS 2N3904/2N3711
4. R63 = 1ST LED
5. REFERENCE DESIGNATIONS ARE ABBREVIATED. SEE TOP ASSY SCHEMATIC LIST.
REVISIONS
ZONE | LTR. | EFFECT. | DESCRIPTION | DATE | APPROVED
QTY REQD | PART OR IDENTIFYING NO. | NOMENCLATURE OR DESCRIPTION | MFR CODE | CIRCUIT REF. | ITEM NO.
PARTS LIST
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'
CONTR. NO.
DRAWN Jim Peuchen 8-12-66
CHECK 8-22-66
APPR 9/20/66
RELEASE DATE 9-30-66
MATERIAL
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA
SCHEMATIC
PROGRAM COUNTER
SERIES X-1
SIZE D
CODE IDENT NO. 03626
36-249
SCALE
WEIGHT
SHEET 2 OF 2
36-218 | 30-218 | 2 | 2
NEXT ASSY | FINAL ASSY | NEXT ASSY | FINAL ASSY
APPLICATION | QTY
36-249 SHEET 2



4. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION SHOWN ON SH 2 OF THE FINAL ASSEMBLY
3. DIODES CR15 THRU CR24 ARE IN3826A (EXCEPT CR18)
2. ALL RESISTORS ARE ¼ W, 5%
⚠ FACTORY SELECTED VALUES, REF. 36-266 SHT. 1.
NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO.

PARTS LIST

36-218	36-218	1	1
NEXT ASSY.	FINAL ASSY.	NEXT ASSY	FINAL ASSY.
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL

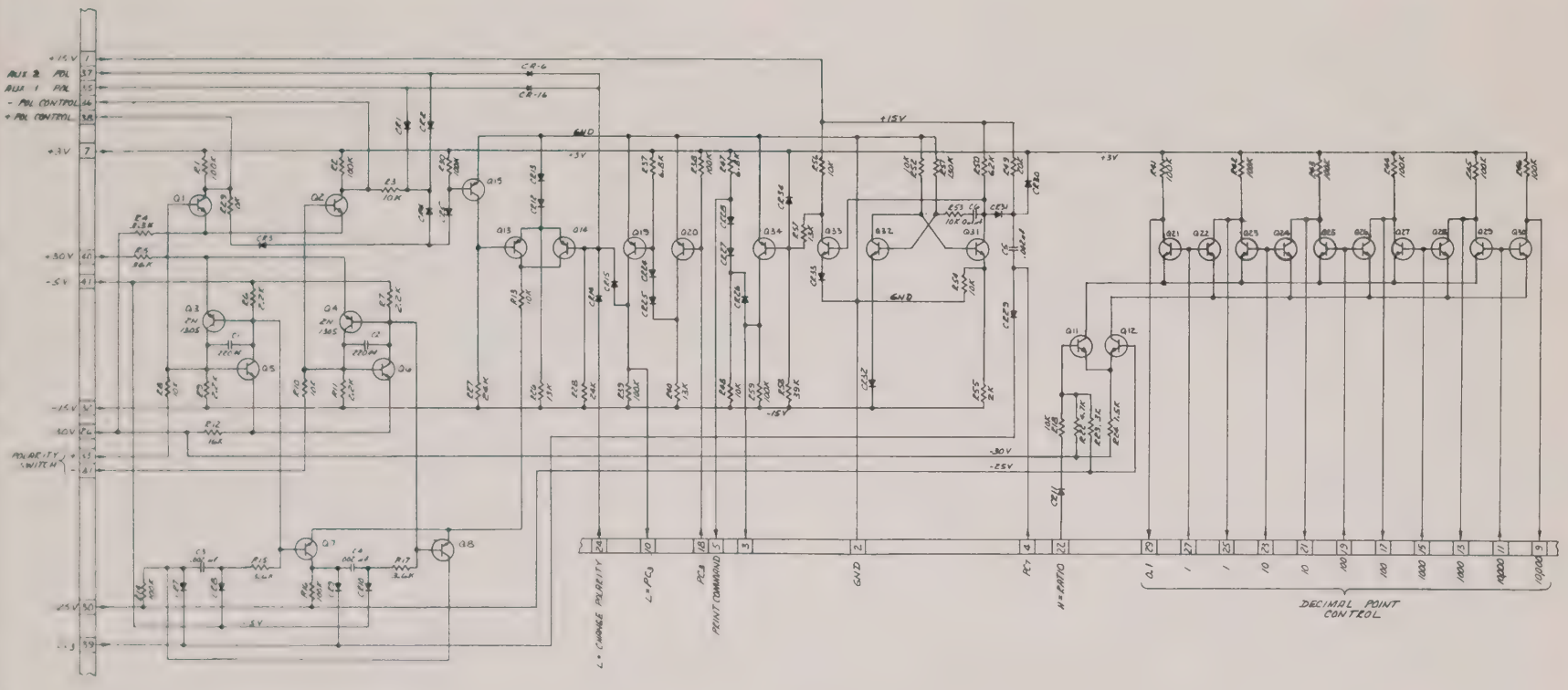
CONTR. NO.
DRAWN H. BRINLEY 8-18-66
CHECK T. Lam 9-27-66
APPR R. Hopkins 9/27/66
RELEASE DATE 9-29-66

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC REGULATOR
SERIES X1

SIZE	CODE IDENT NO.	
D	03626	36-266
SCALE	WEIGHT	SHEET 2 OF 2

36-266 SH. 2



4. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY

3. ALL DIODES NLS 5003-002

2. ALL NPN TRANSISTORS ARE 2N3904/2N3711

1. ALL PNP TRANSISTORS ARE 2N3906/2N3638A/2N3702.

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS					
ZONE	LTR	EFFECT	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED	CONTR. NO.	
DIMENSIONS ARE IN INCHES TOLERANCES ON	DRAWN	Tom Dolkhar 6/24/66
DECIMALS ± .010 ANGLES ± 0° 30'	CHECK	T. Lau 9/14/66
FRACTIONS ± 1/32	APPR	7/27/66
	RELEASE DATE	10-4-66

MATERIAL

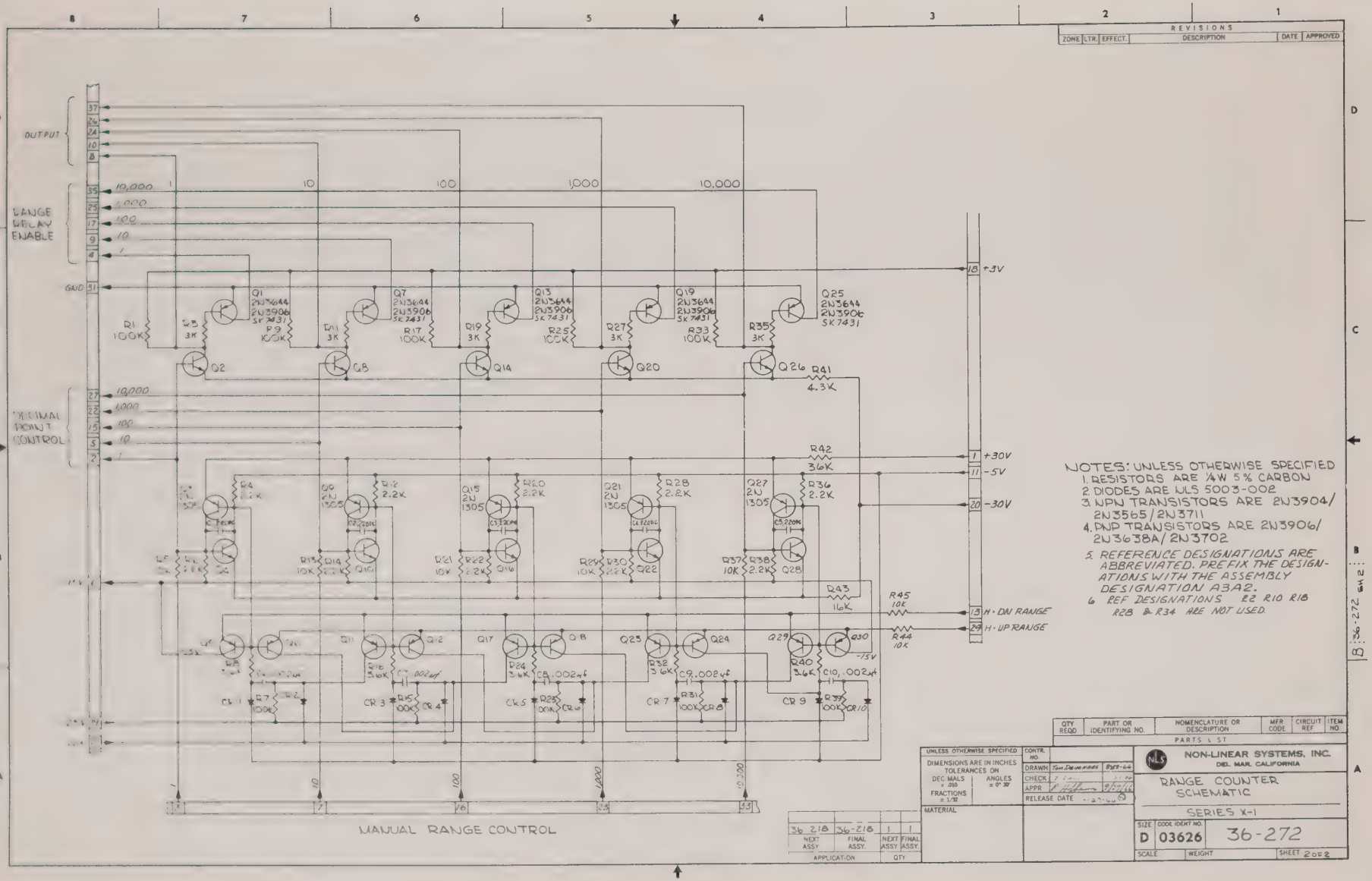
NEXT ASSY.	FINAL ASSY.	NEXT ASSY	FINAL ASSY
36-218	36-218	1	1
APPLICATION		QTY	

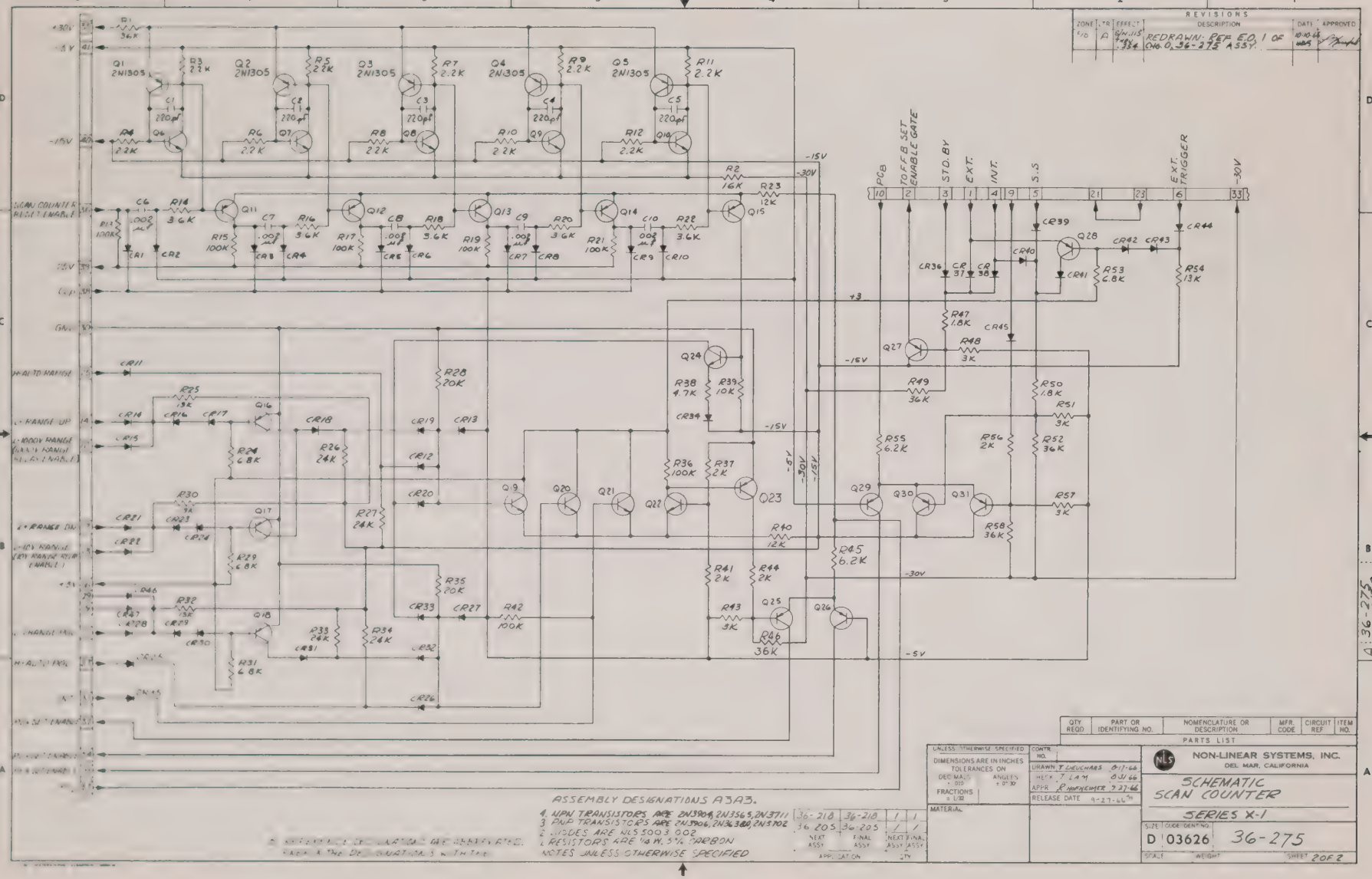
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

POLARITY FLIP-FLOP & LOGIC SCHEMATIC

SERIES X-1

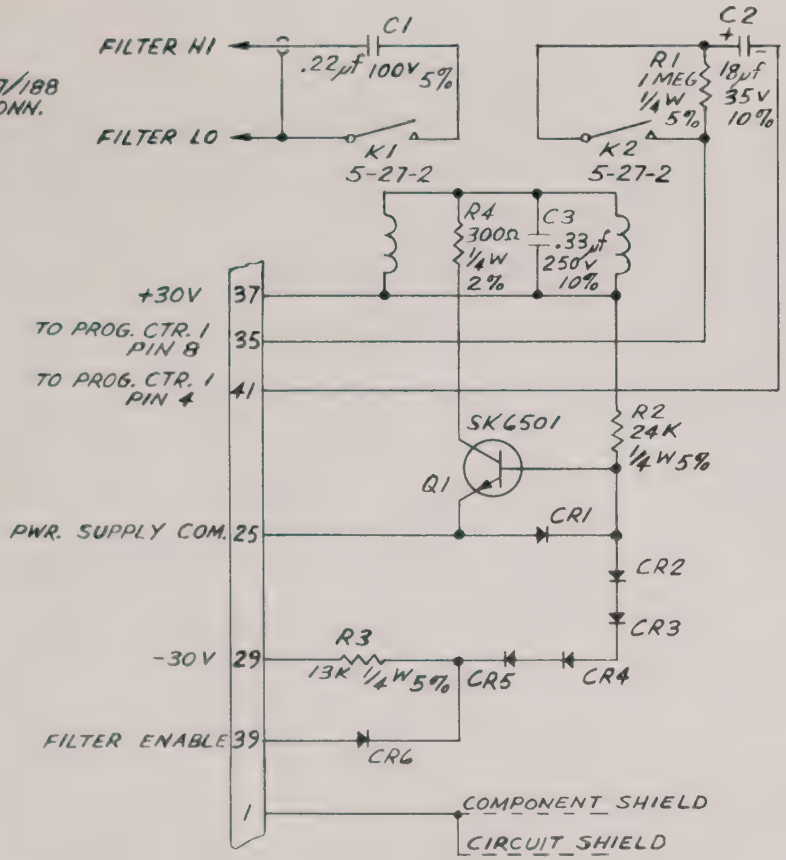
SIZE	CODE IDENT NO	
D	03626	36-269
SCALE	WEIGHT	SHEET 2 OF 2


REVISIONS
ZONE LTR. EFFECT. DESCRIPTION DATE APPROVED
OUTPUT
RANGE RELAY ENABLE
DECIMAL POINT CONTROL
GND
10,000
1,000
100
10
1
+3V
+30V
-5V
-30V
H-DN RANGE
H-UP RANGE
-75V
MANUAL RANGE CONTROL
NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE ¼W 5% CARBON
2. DIODES ARE ULS 5003-002
3. NPN TRANSISTORS ARE 2N3904/ 2N3565/2N3711
4. PNP TRANSISTORS ARE 2N3906/ 2N3638A/2N3702
5. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A3A2.
6. REF DESIGNATIONS R2 R10 R18 R28 & R34 ARE NOT USED.
B 36-272 SH2
QTY REQD | PART OR IDENTIFYING NO. | NOMENCLATURE OR DESCRIPTION | MFR CODE | CIRCUIT REF | ITEM NO.
PARTS LIST
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DEC MALS ± .010 ANGLES ± 0° 30'
FRACTIONS ± 1/32
CONTR. NO.
DRAWN Tom Dickinson 8-8-66
CHECK
APPR
RELEASE DATE
MATERIAL
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA
RANGE COUNTER SCHEMATIC
SERIES X-1
SIZE D | CODE IDENT NO. 03626 | 36-272
SCALE | WEIGHT | SHEET 2 OF 2
36-218 NEXT ASSY | 36-218 FINAL ASSY. | QTY
APPLICATION


REVISIONS
ZONE | LTR | EFFECT | DESCRIPTION | DATE | APPROVED
F/O | A | 6/N.115 | REDRAWN: REF. E.O. 1 OF CH6.0, 36-275 ASSY.
Q1 2N1305
Q2 2N1305
Q3 2N1305
Q4 2N1305
Q5 2N1305
+30V
-15V
-30V
+3
-5V
PCB
TOFF B SET
ENABLE GATE
STO. BY
EXT.
INT.
S.S
EXT. TRIGGER
SCAN COUNTER RESET ENABLE
+ RANGE UP
- RANGE DN
CHANGE LIM
ASSEMBLY DESIGNATIONS A3A3.
1. NPN TRANSISTORS ARE 2N3904, 2N3565, 2N3711
3. PNP TRANSISTORS ARE 2N3906, 2N3638, 2N3702
2. DIODES ARE NLS 5003 OR 004
4. RESISTORS ARE 1/4 W, 5% CARBON
NOTES UNLESS OTHERWISE SPECIFIED
36-218 | 36-218
36-205 | 36-205
NEXT ASSY | FINAL ASSY | NEXT ASSY | FINAL ASSY
APP. | DATE | QTY
QTY REQD | PART OR IDENTIFYING NO. | NOMENCLATURE OR DESCRIPTION | MFR. CODE | CIRCUIT REF. | ITEM NO.
PARTS LIST
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL
CONTR NO.
DRAWN T. DEUCHARS 6-17-66
CHK'D J. LAM 6-21-66
APPR R. HOHENEMSER 7-27-66
RELEASE DATE 9-27-66
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA
SCHEMATIC
SCAN COUNTER
SERIES X-1
SIZE | CODE IDENT NO. | DWG NO.
D | 03626 | 36-275
SCALE | WEIGHT | SHEET 2 OF 2
A | 36-275 SH 2

REVISIONS					
ZONE	LTR	EFFECT	DESCRIPTION	DATE	APPROVED

36-296 SH2



2. DIODES ARE NLS 5003-002.
1. REFERENCE DESIGNATIONS ARE ABBREVIATED SEE TOP ASS'Y. SCHEMATIC LIST.

NOTES: UNLESS OTHERWISE SPECIFIED.

NEXT ASSY	FINAL ASSY	NEXT ASSY	FINAL ASSY
36-218	36-218	1	1
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

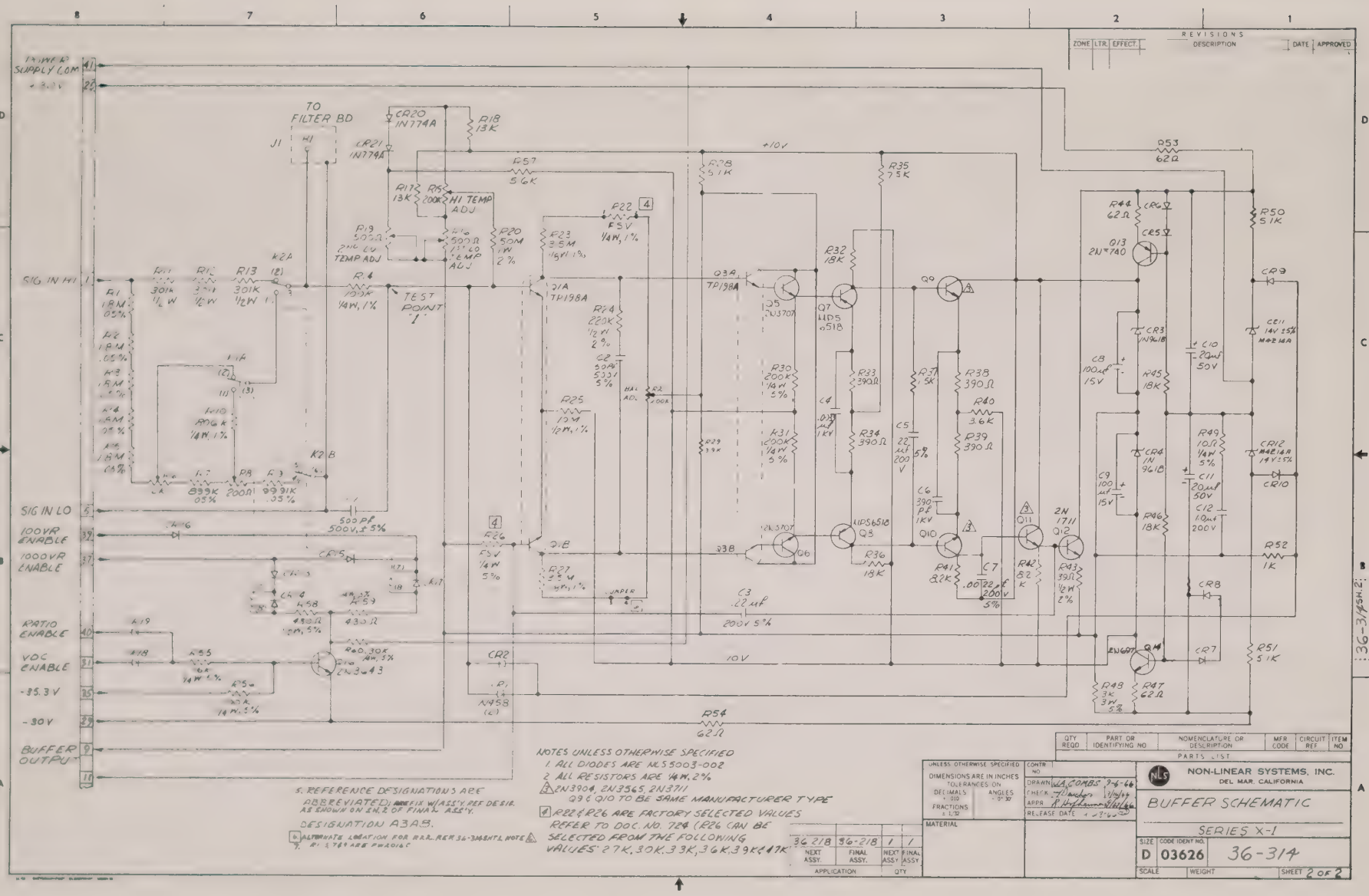
MATERIAL

CONTR NO		
DRAWN	WICKLAND	8-26-66
CHECK		10-3-66
APPR		10-3-66
RELEASE DATE	10-3-66	

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

FILTER ASSEMBLY SCHEMATIC

SIZE	CODE IDENT NO	
B	03626	36-296
SCALE	WEIGHT	SHEET 2 OF 2



NOTES UNLESS OTHERWISE SPECIFIED
1. ALL DIODES ARE MS5003-002
2. ALL RESISTORS ARE 1/4W, 2%
3. 2N3904, 2N3565, 2N3711 Q9 & Q10 TO BE SAME MANUFACTURER TYPE
4. R22 & R26 ARE FACTORY SELECTED VALUES REFER TO DOC. NO. 724 (R26 CAN BE SELECTED FROM THE FOLLOWING VALUES: 27K, 30K, 33K, 36K, 39K, 47K)
5. REFERENCE DESIGNATIONS ARE ABBREVIATED; PREFIX W/ASS'Y REF DESIG. AS SHOWN ON SHT. 2 OF FINAL ASS'Y.
6. ALTERNATE LOCATION FOR R22, R26, R9, & R59 ARE PARALLEL

DESIGNATION A3A3.

REVISIONS				
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO

PARTS LIST

APPLICATION		QTY
36-218 NEXT ASSY.	36-218 FINAL ASSY.	1 NEXT ASSY	1 FINAL ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL
CONTR NO
DRAWN W.A. COMBS 9-6-66
CHECK
APPR
RELEASE DATE

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

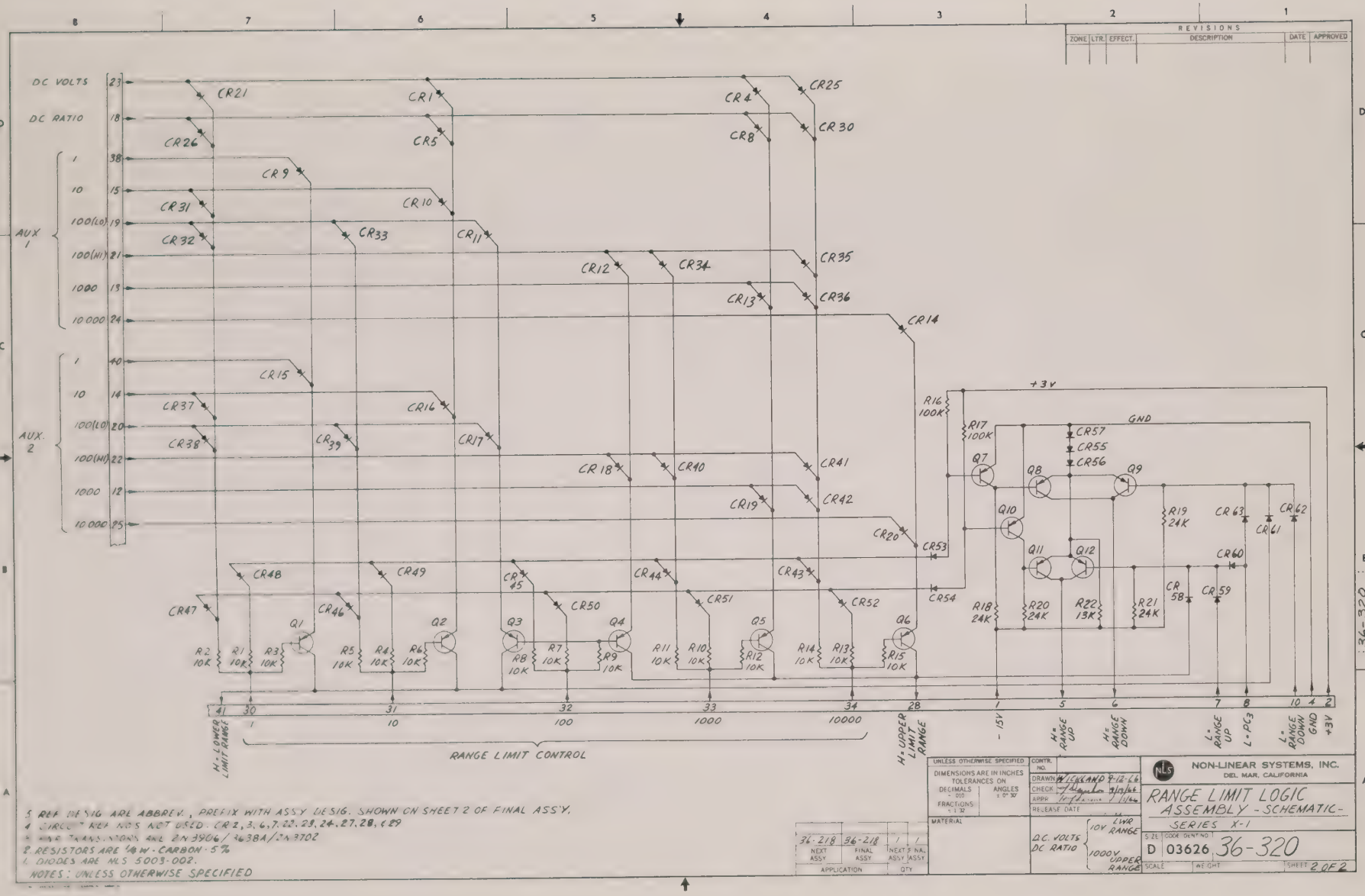
BUFFER SCHEMATIC

SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-314

SCALE | WEIGHT | SHEET 2 OF 2

36-314 SH. 2



5. REF DESIG ARE ABBREV., PREFIX WITH ASSY DESIG. SHOWN ON SHEET 2 OF FINAL ASS'Y.
4. CIRCUIT REF NOS NOT USED: CR2, 3, 6, 7, 22, 23, 24, 27, 28, 689
3. 4NP TRANSISTORS ARE 2N3906 / 2638A / 2N3702
2. RESISTORS ARE 1/8 W - CARBON - 5%
1. DIODES ARE NLS 5003-002.

NOTES: UNLESS OTHERWISE SPECIFIED

36-218 NEXT ASSY	36-218 FINAL ASSY	/ NEXT ASSY	/ NAL ASSY
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS .XXX ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO.
DRAWN W. ICKLAND 7-12-66
CHECK [illegible] 7/13/66
APPR. [illegible] 7/14/66
RELEASE DATE

MATERIAL

D.C. VOLTS / D.C. RATIO: 10V RANGE, 1000V UPPER RANGE

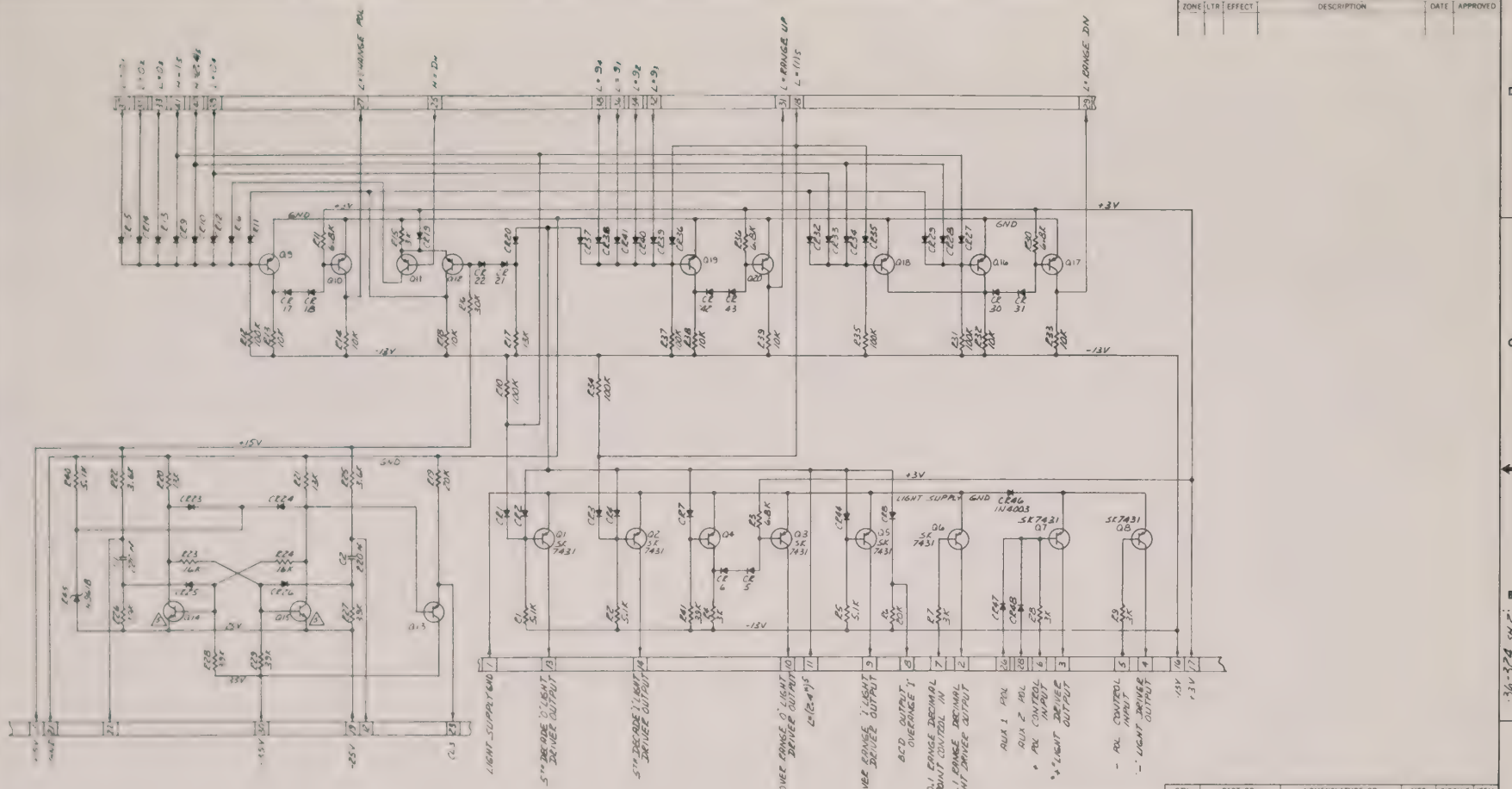
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

RANGE LIMIT LOGIC ASSEMBLY - SCHEMATIC -

SERIES X-1

SIZE D | CODE IDENT NO. 03626 | 36-320

SCALE | WEIGHT | SHEET 2 OF 2



4. NPN TRANSISTORS ARE SK 6501/2N3304.
4. PNP TRANSISTORS ARE 2N3906/2N3638A/2N3702
DIODES NLS 5003-002.
RESISTORS ¼W 5%
REF DESIG ARE ABBREV.; PREFIX WITH ASSY. DESIG. SHOWN ON SH.2 OF FINAL ASSY

NOTES; UNLESS OTHERWISE SPECIFIED

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO
36-218	36-218	NEXT ASSY	FINAL ASSY	1	1
APPLICATION				NEXT ASSY QTY	FINAL ASSY QTY

PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

CONTR NO
DRAWN 3-22-66
CHECK 3-24-66
APPR 3/30/66
RELEASE DATE 4-30-66

MATERIAL

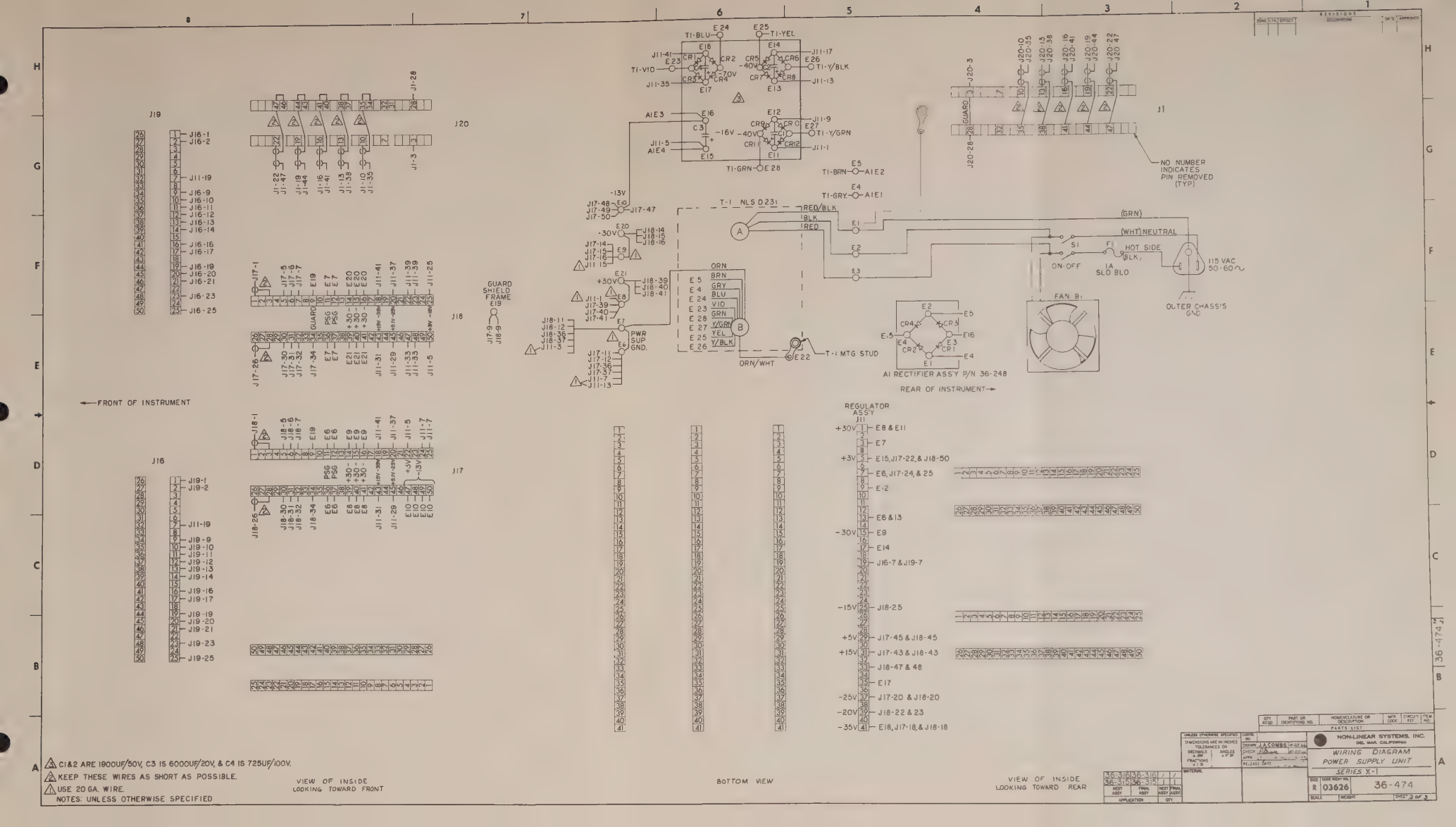
NON-LINEAR SYSTEMS, INC.
DEL MAR CALIFORNIA

SCHEMATIC - RANGE DECISION LOGIC
SERIES X-1

SIZE D | CODE IDENT NO. 03626 | 36-324

SCALE | WEIGHT | SHEET 2 of 2

36-324 SH 2

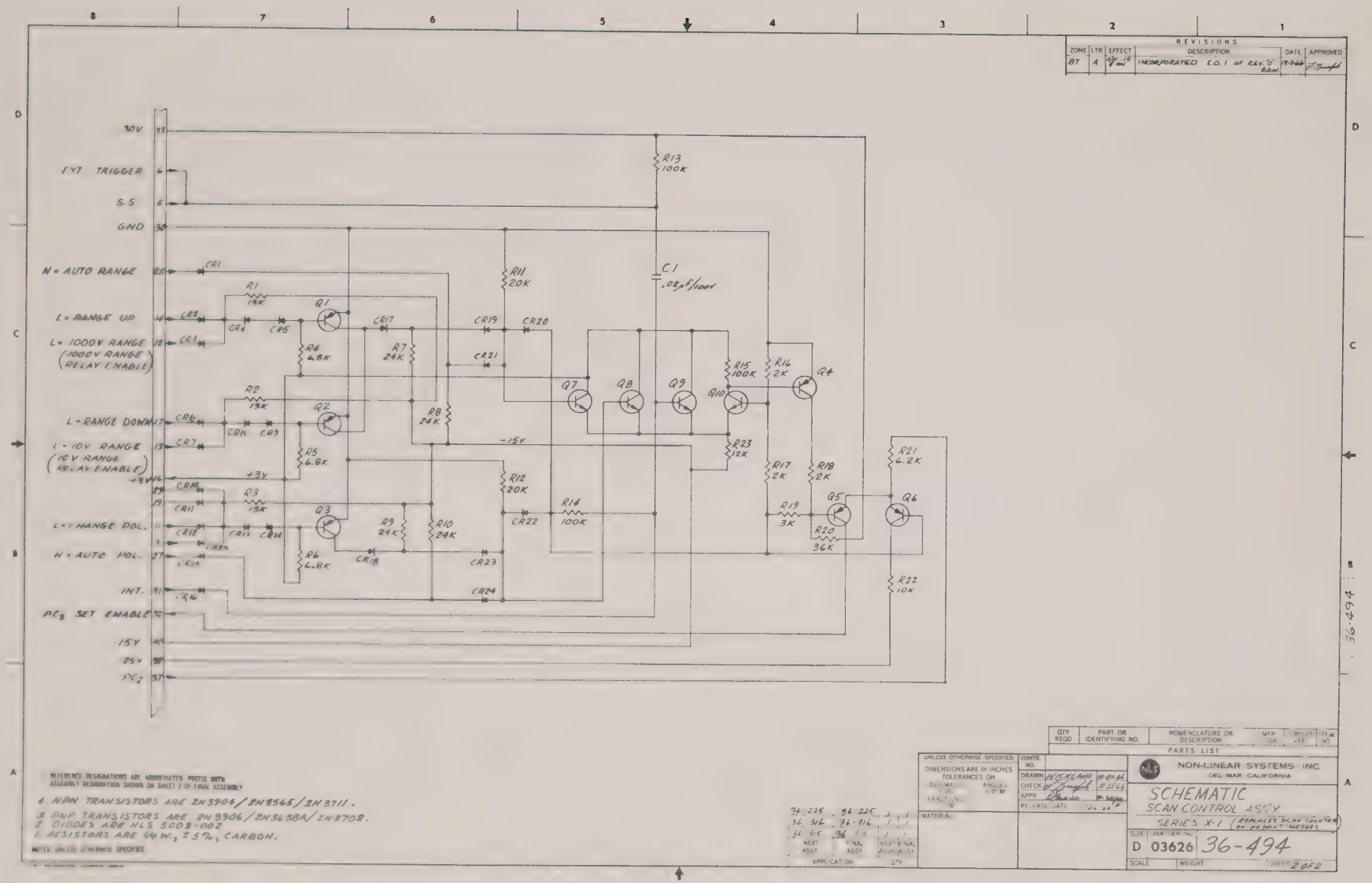


C1&2 ARE 1900UF/50V, C3 IS 6000UF/20V, & C4 IS 725UF/100V.

KEEP THESE WIRES AS SHORT AS POSSIBLE.

USE 20 GA. WIRE.

NOTES: UNLESS OTHERWISE SPECIFIED



REFERENCE DESIGNATORS ARE ABBREVIATED PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 1 OF FINAL ASSEMBLY

4. NPN TRANSISTORS ARE 2N3904/2N3565/2N3711.
5. PNP TRANSISTORS ARE 2N3906/2N3638A/2N3702.
7. DIODES ARE NLS 5003-002
1. RESISTORS ARE 1/4W., 1%, CARBON.

NOTES UNLESS OTHERWISE SPECIFIED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	WEIGHT	ITEM NO

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ANGLES FRACTIONS

CONTR. NO.
DRAWN W.K.S. 10-24-66
CHECK J. Trumpfheller 12-5-66
APPR [illegible] 12-30-66
RELEASE DATE 12-30-66
MATERIAL

36-225 36-225
36-316 36-316
36-5?5 36-?? ? ? ?
NEXT ASSY FINAL ASSY NEXT ASSY FINAL ASSY
APPLICATION QTY

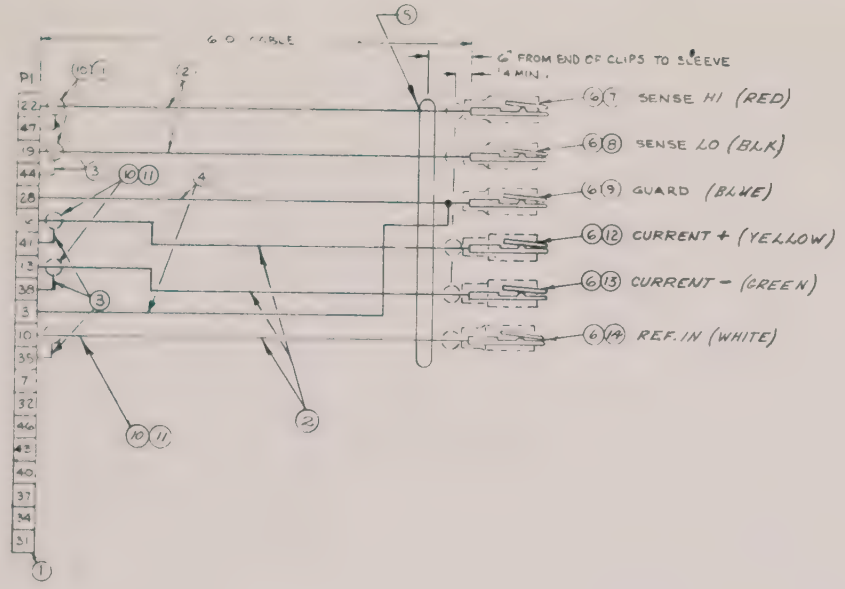
NON-LINEAR SYSTEMS INC
DEL MAR CALIFORNIA

SCHEMATIC
SCAN CONTROL ASS'Y
SERIES X-1 (REMOTE SCAN CONTROL ON MOUNTING METERS)

SIZE D | CODE IDENT NO. 03626 | DRAWING NO. 36-494
SCALE | WEIGHT | SHEET 2 OF 2

36-494

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
1B	A	ALL	ADDED INSERT PART NO. TO ITEM 1. ADDED WIRE LENGTH. WAS A/R	11-Jan	



NOTES:
1. STAMP PART NO. 15004-525 ON SLEEVING.
2. STAMP SYMBOL P1 ON SLEEVING NEAR CONNECTOR.
3. REMOVE ALL PINS NOT SHOWN ON P1.

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.
1	62-WHITE	INSULATOR, WHT. VINYL	95432		14
1	62-GREEN	INSULATOR, GRN. VINYL	95432		13
1	62-YELLOW	INSULATOR, YEL VINYL	95432		12
10	3/16 x 2 1/2	TUBING, SHRINK	THERMOFIT		11
5	323930	TERMASHIELD	89110		10
1	62 BLUE	INSULATOR, BLUE VINYL	95432		9
1	62 BLACK	" , BLACK VINYL	"		8
1	62-RED	INSULATOR, RED VINYL	"		7
6	60-CS	CLIP COPPER	95432		6
5'6"	V105	SLEEVING, VINYL 3/16 I.D BLK.	05593		5
12'	#20 AWG	WIRE STRANDED - BLK.			4
15"	#22 AWG	WIRE, STRANDED - BLK.			3
30'	26 (4A/W)	COAX HL CABLE #3269	70903		2
1	57-30509/ST 1222	CONNECTOR - 50 PIN WITH HI BARRIER INSERT	02660	P1	1

PARTS LIST

UNLESS OTHERWISE SPECIFIED	CONTR. NO.	
DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ± .010 ANGLES ± 0° 30' FRACTIONS ± 1/32	DRAWN	W.ACOMBS 3/2/66
	CHECK	
	APPR	
	RELEASE DATE	
MATERIAL		

36-18	36-18	1	1
NEXT ASSY	FINAL ASSY.	NEXT ASSY	FINAL ASSY
APPLICATION		QTY.	

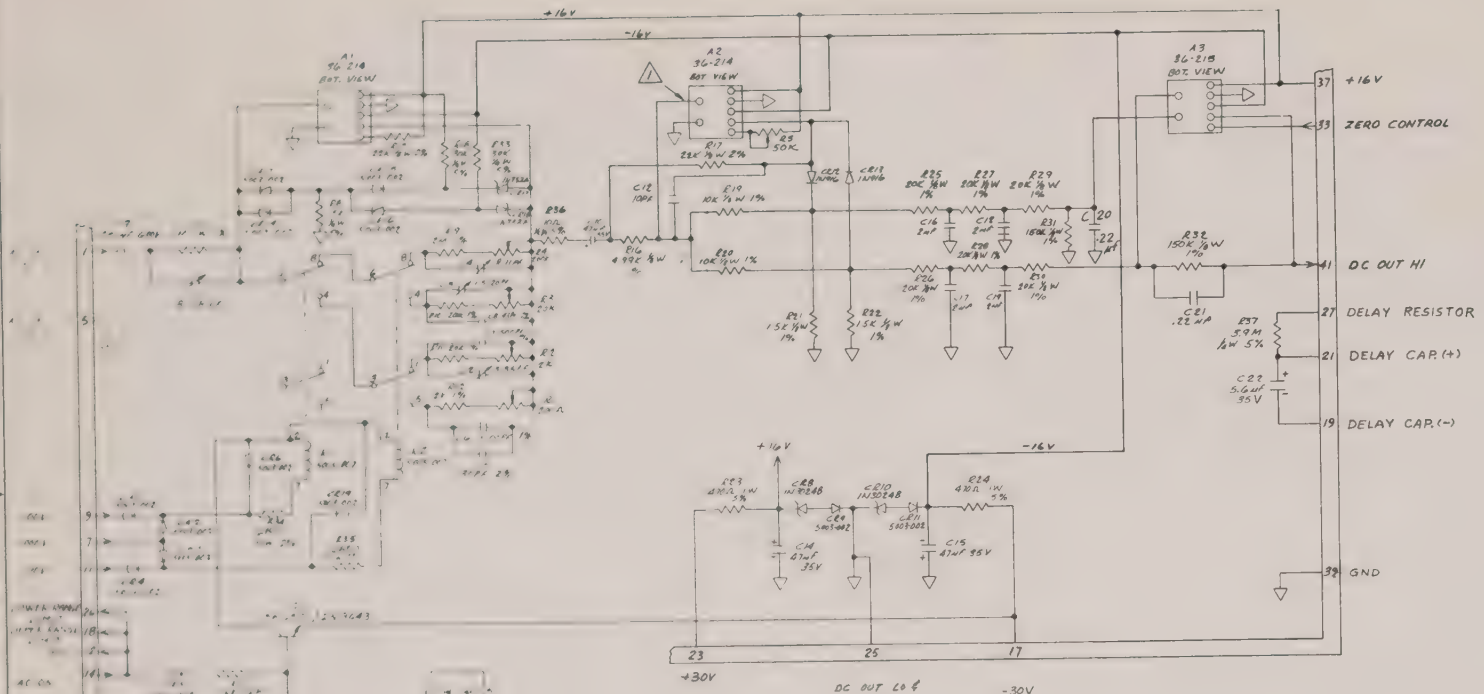
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

CABLE - INPUT

USED ON SERIES X-1

SIZE	CODE IDENT NO.	
C	03626	15004-525
SCALE NONE	WEIGHT	SHEET 1 of 1

15004-525



CALIBRATION INSTRUCTIONS

PROC NO	RANGE	INPUT	ADJUST (FRONT PANEL CONTROL)
1	1000V	0	
2	1000 V	500V - 200 HZ	R1
3	1000 V	500V - 10K HZ	C1
4	100 V	100V - 200 HZ	R2
5	100 V	100V - 10K HZ	C2
6	10V	10V - 200 HZ	R3
7	10 V	10V - 10K HZ	C3
8	1V	1V - 200 HZ	R4
9	1V	1V - 10K HZ	C4

REFERENCE DESIGNATIONS ARE ABBREVIATED PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 1 OF FINAL ASSEMBLY

⚠ THIS POINT SHOULD MEASURE 0v ± 1 MV. IF NOT, ADJUST R5.

REVISIONS					
ZONE	LTR	EFFECT	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO.

PARTS LIST

NEXT ASSY	FINAL ASSY	NEXT ASSY	FINAL ASSY
SG 218	SG 210	1	1
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL

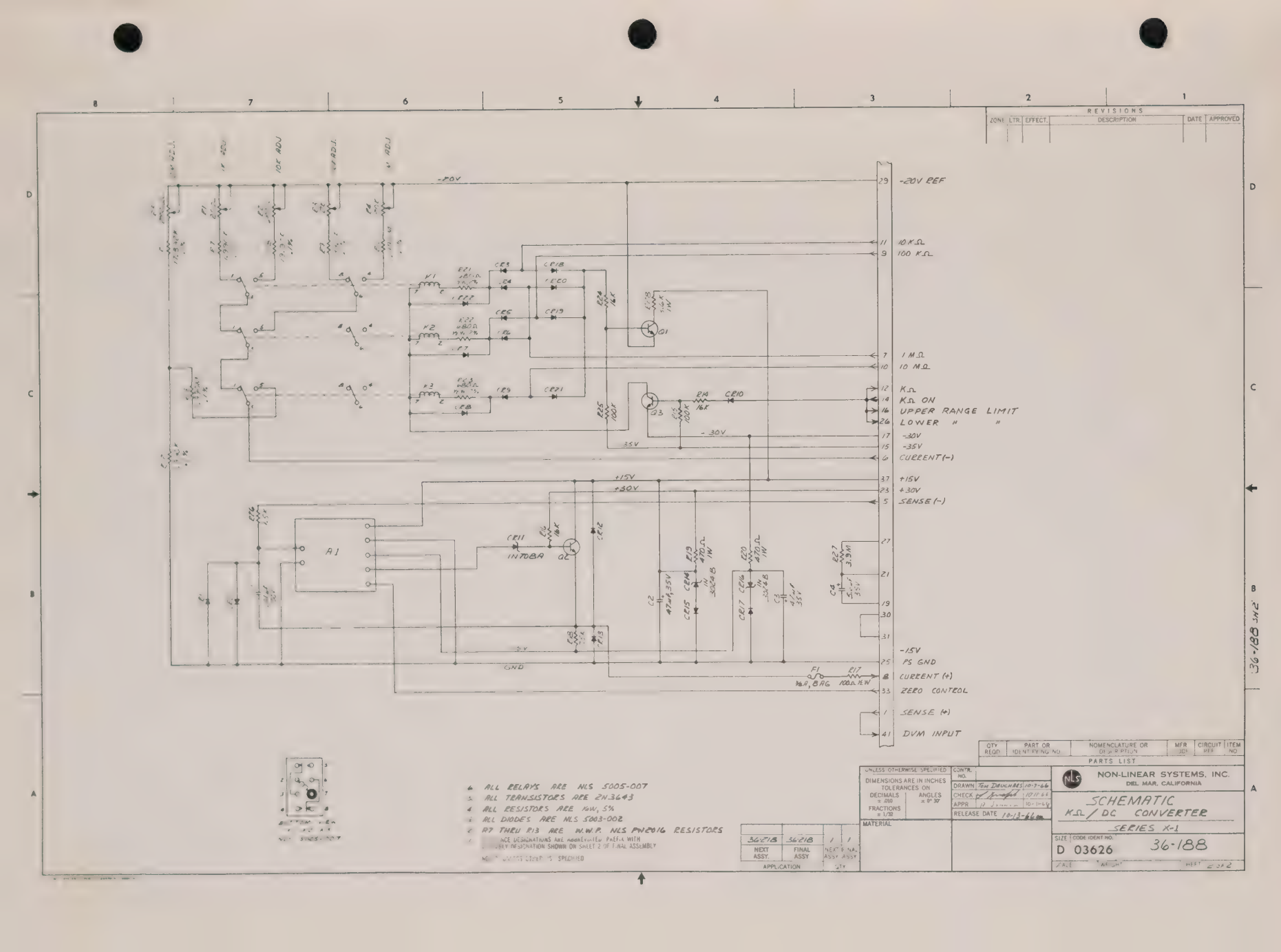
CONTR. NO.
DRAWN WEINBERG 7-29-66
CHK'D 10-17-66
APPR
RELEASE DATE

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC
AC/DC CONVERTER
SERIES X1

SIZE D | CODE IDENT NO 03626 | 36-97
SCALE | WEIGHT | SHEET 2 OF 2

36-97 SH 2



REVISIONS					
ZONE	LTR	EFFECT	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO.

PARTS LIST

1. ALL RELAYS ARE NLS 5005-007
2. ALL TRANSISTORS ARE 2N3643
3. ALL RESISTORS ARE 1/2W, 5%
4. ALL DIODES ARE NLS 5003-002
5. R7 THRU R13 ARE W.W.P. NLS PW2016 RESISTORS
6. REFERENCE DESIGNATIONS ARE ASSEMBLED PREFIX WITH ASSEMBLY NUMBER SHOWN ON SHEET 2 OF FINAL ASSEMBLY
7. UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED	CONTR. NO.
DIMENSIONS ARE IN INCHES	DRAWN Tom Deuchars 10-3-66
TOLERANCES ON DECIMALS ± .010	CHECK 10/11/66
ANGLES ± 0° 30'	APPR 10-14-66
FRACTIONS ± 1/32	RELEASE DATE 10-13-66
MATERIAL	

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

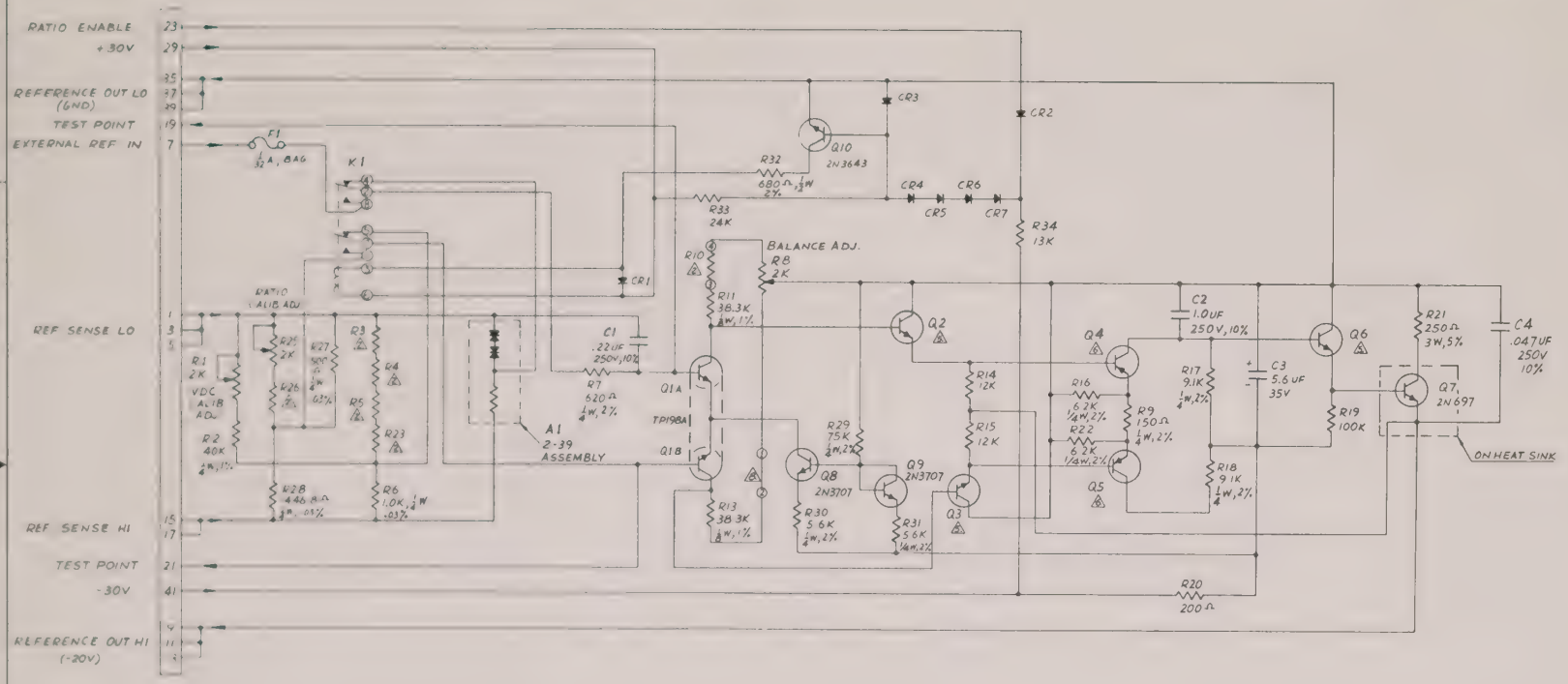
SCHEMATIC
KΩ / DC CONVERTER
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-188

DATE | APPROVED | SHEET 2 OF 2

36218 NEXT ASSY	36218 FINAL ASSY	1 NEXT ASSY	1 FINAL ASSY
APPLICATION		QTY	

36-188 SH 2



10 REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH THE ASSEMBLY DESIGNATION A3A10.

9 REFER TO DOC NO. 765 FOR ADJUSTING R25 & FOR SELECTION OF R26.

⚠ ALTERNATE LOCATION FOR R10. REF 36-195 SHT 1 NOTE 4

7 DIODES ARE 5003-002

⚠ 2N3643, 2N3644, MPS6518, 2N5102

⚠ 2N3906, 2N3711, 2N3565

4 DOCUMENT 719 GIVES INSTRUCTION FOR ADJUSTING R1

3 DOCUMENT 715 GIVES INSTRUCTION FOR ADJUSTING R8.

⚠ RESISTORS R1, 4, 5, 10 & 23 ARE SELECTED, SEE DOC 715.

1 RESISTORS ARE 1/4W, 5%

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS					
ZONE	LTR	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO

PARTS LIST

36-383	36-383	1	1
NEXT ASSY	FINAL ASSY	NEXT ASSY	FINAL ASSY
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'
MATERIAL

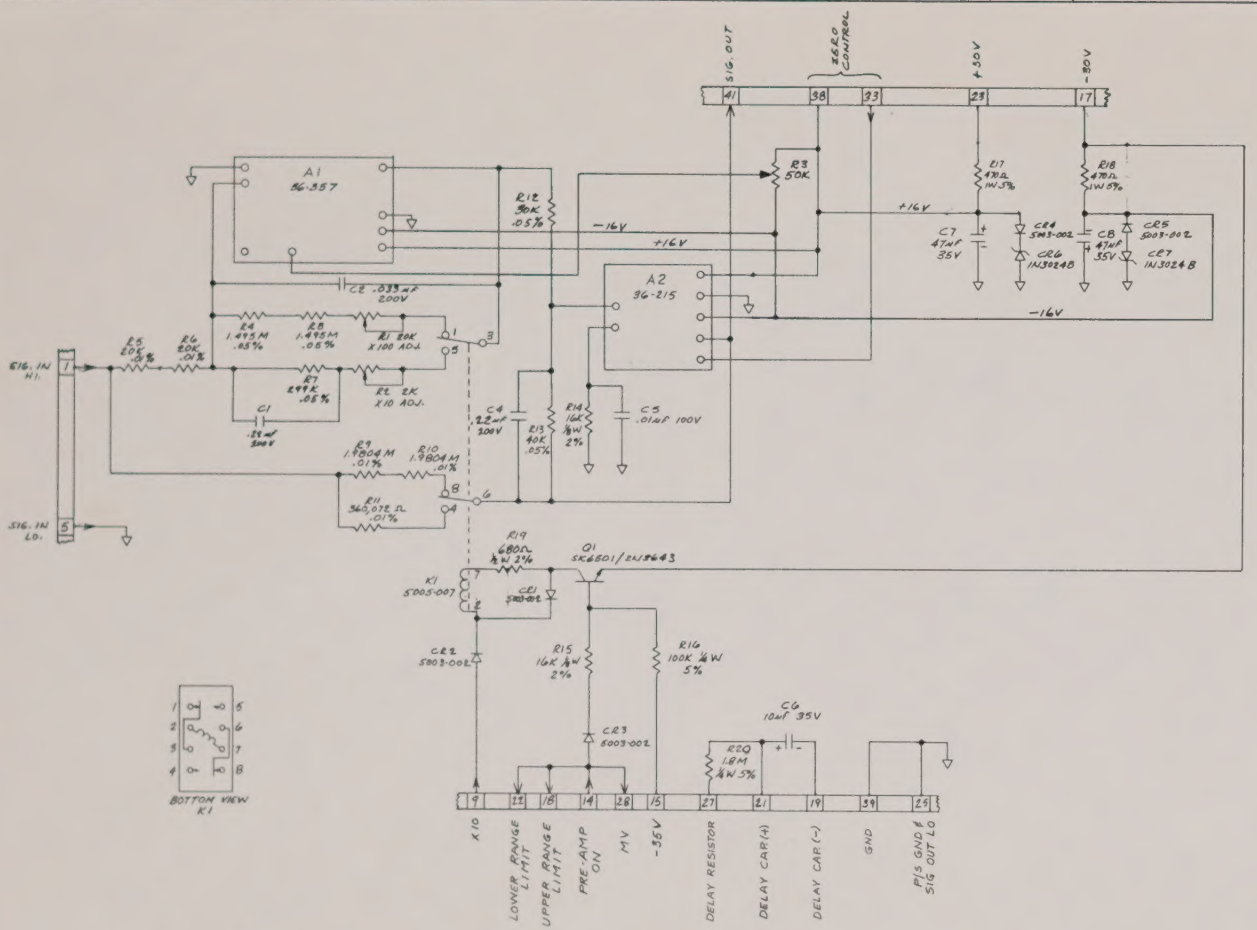
CONTR NO
DRAWN H BRINLEY 8-1-66
CHECK [illegible] 8-16-66
APPR [illegible] 8-16-66
RELEASE DATE 8-17-66

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC, RATIO REFERENCE SUPPLY
SERIES X1

SIZE	CODE IDENT NO	
D	03626	36-195
SCALE	WEIGHT	SHEET 2 of 2

36-195 SHT 2



NOTES:

1. R4 THRU R13 ARE NLS W.W.P. PW2016 RESISTORS.

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

36-218 NEXT ASSY.	36-218 FINAL ASSY.	1 NEXT ASSY.	1 FINAL ASSY.
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .005
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO.
DRAWN WEINBERG 7-29-66
CHECK [illegible] 10-17-66
APPR R. JOHNSON 10-17-66
RELEASE DATE 10-18-66

MATERIAL
SEE SH-1

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

-SCHEMATIC- PRE-AMPLIFIER

SERIES X1

SIZE	CODE IDENT NO.	
D	03626	36-234

SCALE | WEIGHT | SHEET 2 OF 2

36-234 SH2

non linear systems, inc.

DEL MAR, CALIFORNIA

MP MASTER

MA33824